

**Ontario Geological Survey
Report 200**

**Geology of the
Beckington Lake Area**

District of Thunder Bay

Compliments of
ONTARIO
MINISTRY OF NORTHERN DEVELOPMENT
AND MINES
N.F. Trowell
Not for resale
1981



**Ministry of
Natural
Resources**

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Minister**

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Deputy Minister**

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Geological Map

(back pocket)

Map 2431 (coloured)-Beckington Lake area, District of Thunder Bay.
Scale 1:31 680 or 1 inch to $\frac{1}{2}$ mile.

CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

If the reader wishes to convert imperial units to SI (metric) units or SI units to imperial units the following multipliers should be used:

CONVERSION FROM SI TO IMPERIAL

SI Unit Multiplied by Gives

CONVERSION FROM IMPERIAL TO SI

Imperial Unit Multiplied by Gives

LENGTH

1 mm	0.039 37	inches	1 inch	25.4	mm
1 cm	0.393 70	inches	1 inch	2.54	cm
1 m	3.280 84	feet	1 foot	0.304 8	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	1.609 344	km

AREA

1 cm ²	0.155 0	square inches	1 square inch	6.451 6	cm ²
1 m ²	10.763 9	square feet	1 square foot	0.092 903 04	m ²
1 km ²	0.386 10	square miles	1 square mile	2.589 988	km ²
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha

VOLUME

1 cm ³	0.061 02	cubic inches	1 cubic inch	16.387 064	cm ³
1 m ³	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m ³
1 m ³	1.308 0	cubic yards	1 cubic yard	0.764 555	m ³

CAPACITY

1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	4.546 090	L

MASS

1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	31.103 476 8	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	0.453 592 37	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	907.184 74	kg
1 t	1.102 311	tons (short)	1 ton (short)	0.907 184 74	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	1016.046 908 8	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	1.016 046 908 8	t

CONCENTRATION

1 g/t	0.029 166 6	ounce (troy)/ton (short)	1 ounce (troy)/ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ton (short)	1 pennyweight/ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy)/ton (short)	20.0	pennyweights/ton (short)
1 pennyweight/ton (short)	0.05	ounce (troy)/ton (short)

NOTE—Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries published by The Mining Association of Canada in co-operation with the Coal Association of Canada.

ABSTRACT

The Beckington Lake map-area covers about 425 km² in the Patricia Mining Division, District of Thunder Bay, about 93 km east of Sioux Lookout. The area is underlain by an Early Precambrian (Archean) sequence of metavolcanic, metasedimentary, and intrusive rocks comprising part of the Wabigoon Metavolcanic-Metasedimentary Belt in the Superior Province of the Canadian Shield.

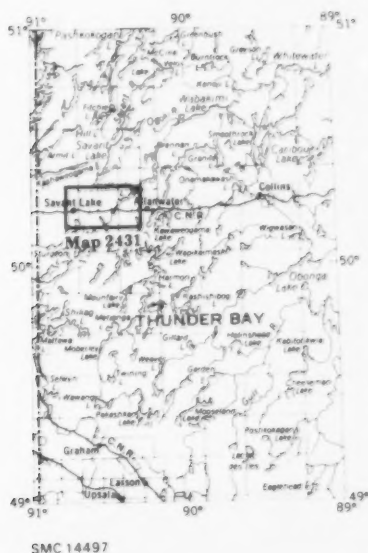


Figure 1—Key map showing location of Beckington Lake area.
Scale 1:3 168 000.

Mafic metavolcanics predominate in the southern part of the area whereas flows and fragmental rocks of felsic to intermediate composition increase in amount to the north. Two major assemblages of metasediments are present and volcanogenic metasediments occur intercalated within the metavolcanic assemblages. The metavolcanic and volcanogenic metasediments are intruded by gabbro and diorite bodies. The metavolcanic-metasedimentary sequence is bounded on both the east and west by composite granitic complexes.

The volcanic and sedimentary rocks have been subjected to a greenschist to lower amphibolite facies rank of metamorphism, and although higher rank metamorphic rocks are present adjacent to the composite granitic complexes, the metamorphic rank is highly variable both parallel to and across strike within the metavolcanic-metasedimentary assemblage. The metamorphism is especially complicated in the northwestern part of the area where several indicator minerals including kyanite, andalusite, sillimanite, staurolite, cordierite, diopside, garnet, and anthophyllite indicate an upper greenschist to lower amphibolite facies rank of metamorphism.

The northern part of the area comprises a basal unit of north-facing amphibolitized mafic metavolcanics unconformably overlain by a sequence of polymictic conglomerate and arenaceous metasediments. An east-facing antiformal sequence of metavolcanics overlies the conglomerate. The southern part of the area comprises a predominantly east-facing monoclinial sequence though the stratigraphic position of the eastern assemblage of amphibolitized mafic metavolcanics is uncertain.

Pyrite, with minor chalcopyrite, and trace gold values locally occur in silicified zones at the contact between mafic intrusive rocks and felsic to intermediate metavolcanics. Two occurrences of sulphide mineralization, the Savant Lake Cu-Pb-Zn-Ag deposit and the Hadley Zn-Pb-Cu-Ag-Cd deposit occur in felsic to intermediate fragmentals and volcanogenic metasediments, respectively, in the northwestern part of the area. Thin units of iron formation are intercalated within the metasediments and pyroclastic rocks.

Geology of the Beckington Lake Area District of Thunder Bay

by

N.F. Trowell¹

INTRODUCTION

The centre of the Beckington Lake map-area is approximately 93 km east of Sioux Lookout, Ontario (Figure 1). The map-area includes the townships of Boucher and Chevrier and unsurveyed land to the west and south, a total area of approximately 425 km² that is bounded by Latitudes 50°09'30''N and 50°19'30''N and Longitudes 90°25'15''W and 90°45'00''W. The map-area is in the District of Thunder Bay and in the Patricia Mining Division. The geological mapping program covering this area was carried out during the spring and summer months of 1974 and 1975 and represents the seventh and eighth years respectively, of geological mapping by the author, in the Sturgeon Lake-Savant Lake region.

Acknowledgments

Assistance in the field was provided by W.D. Gordanier, T. Stirbys, B. Cooke, and B. Sutherland in 1974; and by W. Bulmer, B. Cooke, J. Gagnon, Peter Tindall, Tom Pollock, and B. Anderson in 1975. Messrs. Gordanier, Bulmer, and Cooke, as senior geological assistants, were responsible for approximately 70 percent of the mapping.

Means of Access

Highway 599, that extends northeast at Ignace from Highway 17, passes through the northwest corner of the map-area and provides access to Sturgeon Lake. Several recently constructed lumber roads provide access to Harris,

¹Geologist, Precambrian Geology Section, Ontario Geological Survey, Toronto. Manuscript received by the Chief Geologist, Precambrian Geology Section, May 29th, 1978. This report is published with the permission of E.G. Pye, Director, Ontario Geological Survey.

Beckington Lake Area

Harold, and Jutten Lakes in the northern part and to Beckington Lake in the southern part of the area. The Canadian National Railway line approximately bisects the area into a north and south part respectively.

Sturgeon Lake provides limited access to the southwestern part of the map-area whereas in the eastern part a series of interconnected portages beginning from Beckington Lake allow access to Queen's, Wellington, Vanessa, and Richan Lakes.

Float-equipped aircraft can be chartered from Sioux Lookout, Savant Lake, and Ignace to reach the lakes in the northeastern and far eastern parts of the map-area.

Prospecting and Mining Activity

W. McInnes (1900, p.115A-122A) reported that gold-bearing quartz veins were discovered on Sturgeon Lake, in the summer of 1898, by a prospector named Peter King, and that a number of claims were staked. Intermittent exploration for gold was carried out during the next few years. The construction, in 1909, of the Lake Superior branch of the Grand Trunk Pacific Railway, and the establishment of steamer lines on Sturgeon Lake to facilitate transportation of materials for railway construction, resulted in increased though temporary exploration activity.

During the period 1905 to 1941, the St. Anthony Mine, located just south of the present map-area, produced 63,310 oz. of gold and 16,341 oz. of silver (Ontario Division of Mines, Statistical Files, St. Anthony Gold Mines Limited, Northern Gold Reef Limited).

In October 1969, the Exploration Division of Mattagami Lake Mines Limited discovered a base metal sulphide deposit (now Mattabi Mines Limited) located south of Sturgeon Lake, approximately 50 km southwest of the present map-area. This and subsequent discoveries in the same area stimulated exploration activity in the entire Sturgeon Lake-Savant Lake region (Table 1).

During the years 1974 and 1975 several companies were actively engaged in exploring their respective claim groups in the map-area.

Field Procedure

The area was mapped by the author and assistants during the spring and summer months of 1974 and 1975. Wherever possible, pace and compass traverses were run perpendicular to the regional trend and were spaced 0.4 km (¼ mile) apart. The geological field data were plotted on acetate sheets attached to air photographs at a scale of 1:15 840 (1 inch to ¼ mile). These data were then transferred to a base map, at the same scale, that had been prepared by the Cartography Section, Ontario Division of Lands, from maps of the Forest Resources Inventory, Ontario Ministry of Natural Resources.

Information from property plans and diamond drill hole logs in the assessment work files of the Assessment Files Research Office, Ontario Geological

TABLE 1 BASE METAL SULPHIDE DEPOSITS IN THE STURGEON LAKE REGION, NORTHWESTERN ONTARIO (DATA TAKEN FROM FRANKLIN, J.M.; GIBB, W.; POULSEN, K.H., AND SEVERIN, P., 1977).

Owner	Deposit Name	Discovery Date	Deposit Type	Current Tonnage Estimate (mill. tons)	Zn (In percent)	Cu (In percent)	Pb oz/ton	Ag oz/ton	Au oz/ton
Mattabi Mines Ltd.	Mattabi	September/1969	Zn-Cu-Pb-Ag (-Au)	13 665 880	7.5	0.8	0.77	3.10	
Sturgeon Lake Mines Ltd.	Boundary	October/1970	Zn-Cu-Pb-Ag -Au	2 110 584	10.64	2.98	1.47	6.14	0.021
Mattagami Lake Mines Ltd.	Lyon Lake Creek	October/1971 February/1972	Zn-Cu-Pb-Ag	4 029 500	6.66	1.15	0.63	3.3	

Beckington Lake Area

Survey, Toronto, from Ontario Department of Mines-Geological Survey of Canada aeromagnetic maps; from Ontario Geological Survey Data Series Maps; and from Ontario Geological Survey ground magnetic and gravimetric maps (Barlow 1974; 1975) was also used in the preparation of this report. Additional information was obtained from two undergraduate theses (Bulmer 1976; Cooke 1976) done in conjunction with the mapping of this area.

Two uncoloured preliminary geological maps P.1495 and P.1496 at a scale of 1:15 840 (1 inch to $\frac{1}{4}$ mile) were published in 1977 (Trowell 1977a,b).

The final coloured map (Map 2431, back pocket) is at a scale of 1:31 680 (1 inch to $\frac{1}{2}$ mile). The geology is not tied to surveyed lines.

Previous Geological Work

W. McInnes of the Geological Survey of Canada, was the first geologist known to have described the Sturgeon Lake area; his reports appeared in the Summary Reports of the Geological Survey of Canada, 1899, pages 115A-122A, and 1901, pages 92A-95A. E.J. Davidson (1901, p.207-250) described the area in Survey 9, in Report of the Survey and Exploration of Northern Ontario in 1900. A.P. Coleman (1902, p.147, 148) in his report on the iron ranges of north-western Ontario reported on some of the gold occurrences on Sturgeon Lake. W.G. Miller (1903, p.82-90, 104, 105) described the workings on many of the claims on Savant and Sturgeon Lakes. W.H. Collins (1907, p.103-109) mapped the geology of the area between Lake Nipigon and Sturgeon Lake. E.S. Moore (1910, p.173) visited the area in 1909 to evaluate the iron deposits in the Savant Lake region. Moore (1911, p.133-157), T.L. Gledhill (1924, p.18-39), and A.R. Graham (1931, p.36-50) reported on the geology of the Sturgeon Lake area, whereas Moore (1928, p.52-82) conducted a geological study of the entire Savant Lake area including within this study the northern part of the present map-area. G. Rittenhouse (1936, p.451-478) did a detailed study of the area north of the present map-area in conjunction with his Ph.D. thesis. F.J. Pettijohn (1937) made brief mention to the Sturgeon Lake area in his discussion of the Northern Subprovince of the Lake Superior Region. Though not necessarily covering the present map-area D.P. Rodgers (1964) has given a description of the general Sturgeon Lake region whereas R. Skinner (1969) mapped the entire area at a reconnaissance scale.

Physiography

The elevation of Sturgeon Lake is 1,342 feet above sea level and the maximum local relief is never more than 80 m above this elevation; elevation of a topographic survey monument west of Evans Lake is 1,583 feet a.s.l.¹

¹Elevations taken from Sioux Lookout topographic sheet 52J, Department of Energy, Mines, and Resources, Ottawa. Scale 1:250 000.

The relief reflects both the differential erosion of the underlying bedrock units and the topography of the Pleistocene and Recent deposits. The major topographic feature in the map-area is a southwest-trending esker and delta complex that has local positive relief of 30 m and that crosses the eastern part of Boucher Township.

A river-system divide separating two major drainage basins passes through the map-area. East of Sturgeon Lake all the lakes including Beckington, Harris, and Harold Lakes drain into the Albany River (Albany River Drainage Basin) and eventually James Bay, while those to the west drain into the English River (English River Drainage Basin) and eventually into Lake Winnipeg.

The entire region has been glaciated, with the deeper lakes occurring in glacially deepened basins in the bedrock, and the shallower lakes in depressions in the glacial deposits themselves. Outcrop distribution is variable from sparse to locally abundant, though individual outcrops are generally small. Away from the roads moss cover of the outcrops is prevalent.

GENERAL GEOLOGY

An Early Precambrian metavolcanic-metasedimentary sequence underlies the central part of the map-area. The sequence varies in width from 5 km to 11 km. It was mapped for 19 km of its length along strike. Two composite granitic complexes, both of which extend outside the map-area, border the metavolcanic-metasedimentary sequence.

The area covers the transitional zone between the Savant Lake and Sturgeon Lake metavolcanic-metasedimentary belts. Table 2 presents the lithological units within the map-area and Table 3 gives the stratigraphic sequence of the Savant Lake area according to past and present workers in the area.

Based upon the distribution and facies relationships of rock lithologies illustrated in Map 2431 accompanying this report the author has subdivided the extension of the Savant Lake metavolcanic-metasedimentary sequence in the map-area into nine lithostratigraphic units which are outlined in Figure 2 and has interpreted six of these units as extending into the Sturgeon Lake metavolcanic-metasedimentary sequence in the southern part of the map-area. In the extension of the Savant Lake belt the units are as follows.

Formation A comprised of a northwest-facing, mafic to intermediate volcanic sequence (Jutten Series of Rittenhouse 1936). The metavolcanics consist predominantly of pillowed flows, minor massive flows, porphyritic flows, autoclastic breccia zones, and intrusive equivalents. Thin interflow intermediate tuffaceous and volcanogenic metasedimentary units mark local hiatus in volcanism.

Formation B is comprised of polymictic conglomerate that contains lenses of wacke-siltstone near the top. The conglomerate contains abundant granitoid clasts, trends northeast, and overlies the Jutten metavolcanics with a marked angular discordance. Formation B varies in thickness and is locally missing because of faulting and intrusion of the Eastern Granitic Complex. In south-central Boucher Township, the

Beckington Lake Area

TABLE 2 | LITHOLOGICAL UNITS OF THE BECKINGTON LAKE AREA

CENOZOIC	
QUATERNARY	
RECENT	Swamp accumulation
PLEISTOCENE	Sand and gravel
	<i>Unconformity</i>
PRECAMBRIAN	
EARLY PRECAMBRIAN (ARCHEAN)	
FELSIC TO INTERMEDIATE INTRUSIVE ROCKS	
	Biotite-hornblende granodiorite, porphyritic hornblende granodiorite (variable to monzonite)
	<i>Intrusive (?) contact</i>
FELSIC TO INTERMEDIATE INTRUSIVE COMPLEXES	
EASTERN GRANITIC COMPLEX, WESTERN GRANITIC COMPLEX	
	Massive to weakly foliated trondhjemite to granodiorite; porphyritic massive to weakly foliated trondhjemite to granodiorite; foliated granodiorite, foliated granodiorite to quartz monzonite; foliated quartz monzonite, foliated porphyritic quartz monzonite to granodiorite; granodiorite to quartz monzonite with inclusions.
	<i>Intrusive Contact</i>
METAMORPHOSED MAFIC INTRUSIVE ROCKS	
	Gabbro, diorite; porphyritic (feldspar) gabbro and diorite
	<i>Intrusive Contact</i>
METAVOLCANICS AND METASEDIMENTS	
METASEDIMENTS	
	Conglomerate; wacke, arenite, siltstone, argillite; iron formation
FELSIC TO INTERMEDIATE METAVOLCANICS	
	Flows/tuffaceous units; porphyritic feldspar flows/tuffs; tuff; lapilli-tuff, lapillistone-tuff; lapillistone-tuff, tuff-breccia; crystal and lithic-crystal tuff; porphyritic flows/hypabyssal intrusions
MAFIC TO INTERMEDIATE METAVOLCANICS	
	Volcanic flows; porphyritic flows; pillowed flows; amygdaloidal flows; tuff, lapilli-tuff; autoclastic breccia; hyaloclastic breccia

plane of unconformity between Formations A and B, in part, controlled the intrusion of the Eastern Granitic Complex. Here, Formation A is not present, and the conglomerate is apparently in direct (though unobserved) contact with granitoid rocks. G.H. Funk (1973) has informally named Formation B, the Savant Lake conglomerate. Formations C to I comprise a predominantly east-facing sequence in

Beckington Lake Area

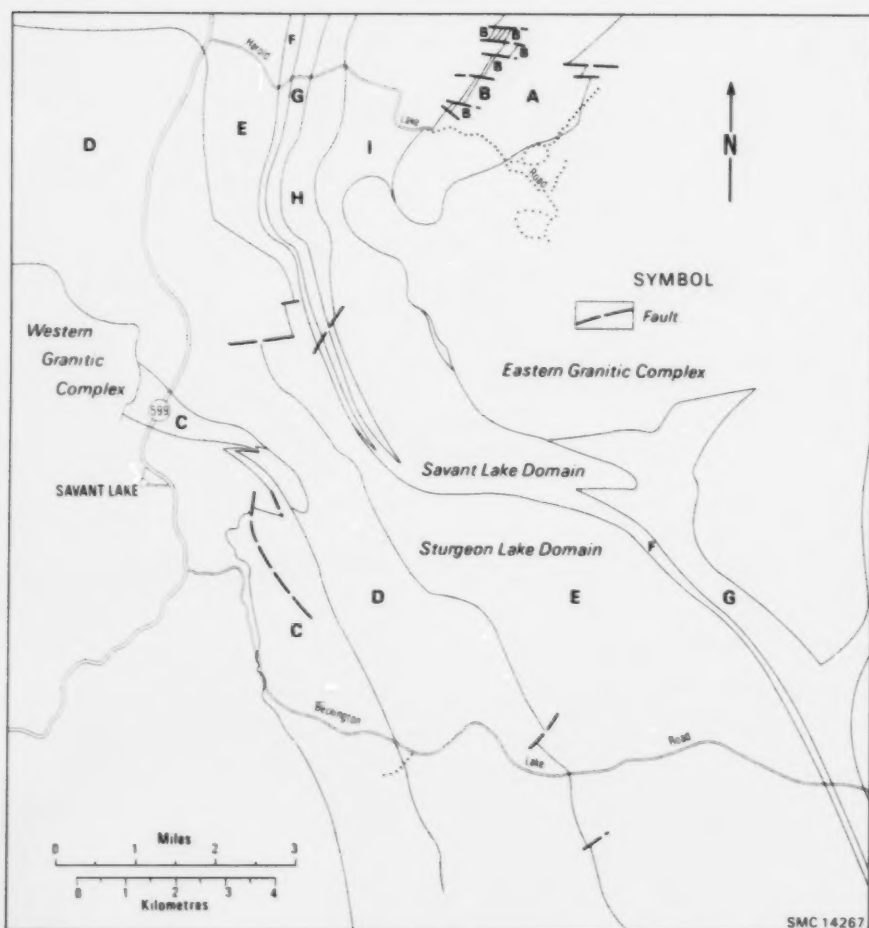


Figure 2—Subdivision of the metavolcanic-metasedimentary sequence.

the western and central parts of the map-area. They are equivalent to the Handy Lake volcanics of Rittenhouse (1936). Formation C is comprised of east-facing mafic to intermediate metavolcanics. The meta-volcanics consist of massive flows, pillowed flows, porphyritic flows, and thin fragmental zones. Thin interflow tuffaceous units are locally present.

Formation D is comprised of a complexly intercalated sequence of felsic to intermediate flows, pyroclastics, and volcanogenic sediments; thin

mafic to intermediate flows, tuffs, and intrusive equivalents, and hypabyssal and extrusive felsic to intermediate units. A small zone of mafic metavolcanics is present in the far western part of Formation D west of Evans Lake.

Formation E is comprised of a mixed sequence of intermediate flows and pyroclastics, with intercalated mafic flows and tuffs, and volcanogenic metasediments. To the east (top) and south this formation is increasingly dominated by mafic flows and tuffs.

Formation F is comprised of a sequence consisting of east-facing wacke, siltstone and argillite metasediments with local zones of felsic to intermediate volcanic clastic rocks and thin units of magnetite iron formation.

Formation G is comprised of a sequence of felsic volcanic clastic rocks with a narrow wedge of metasediments along its northern extension.

Formation H is comprised of a mixed sequence of mafic flows and tuffs with substantial amounts of interflow metasediments and intermediate tuffaceous units. This formation is characterized by the presence of anthophyllitic flows and a carbonaceous iron sulphide-rich wacke zone within the intercalated metasediments.

Formation I comprises a sequence of intermediate to locally felsic pyroclastic and volcanic clastic units with numerous thin units of volcanogenic metasediments and mafic flows.

In contrast to the Savant Lake metavolcanic-metasedimentary belt, the part of the Sturgeon Lake metavolcanic-metasedimentary belt within the southern part of the map-area is dominated by mafic volcanism.

The author is uncertain whether the Jutten volcanic sequence is represented in the Sturgeon Lake metavolcanic-metasedimentary belt. Some of the mafic metavolcanics along the east side of the belt, specifically those in the Rainbow and Devizes Lakes area may be equivalent to the Jutten. There are however no field criteria to indicate that they are.

Formation B is not present in the Sturgeon Lake metavolcanic-metasedimentary belt.

Formation C widens appreciably to the south into the Sturgeon Lake metavolcanic-metasedimentary belt.

Formation D is characterized by the presence of coarse-grained, massive, irregularly-shaped, gabbroic or amphibolitic intrusions. The author interprets Formation D in the map-area to be comprised in part of volcanic detritus from the Savant Lake volcanics to the north and the Northeast Arm volcanics to the south (Trowell 1977c).

Formation E is dominated by mafic volcanic flows though minor thin interflow units of intermediate volcanic clastic and volcanogenic metasedimentary material are present.

The turbiditic metasediments of Formation F are more thinly bedded to the south indicative perhaps of a more distal position with respect to source. Also they contain intercalated units of sulphide iron formation in contrast to the magnetite-bearing iron formation to the north.

It was not possible to trace Formation F in the central part of the map-area because of a lack of outcrops.

Formation G and perhaps H and I are now dominated by mafic volcanism

with only minor thin interflow metasedimentary units being present.

The Eastern Granitic Complex is comprised of foliated granodiorite to quartz monzonite with local trondhjemite phases whereas the Western Granitic Complex, at least that part bordering the metavolcanic-metasedimentary sequence, is comprised predominantly of massive coarse-grained, possibly hypabyssal trondhjemite and granodiorite. Shoreline exposures of granodiorite possibly indicate that a granodiorite sill underlies the lake just to the east of the bottom of Beckington Lake whereas other thin sills of granodiorite were observed in Formations E and G in the Sturgeon Lake area.

In general, the metavolcanic-metasedimentary sequences have been metamorphosed to amphibolite facies rank adjacent to the granitic complexes and generally greenschist facies in the internal part of the sequences. In detail, however, it would appear that the metamorphic history of the area is more complex involving a general increase in grade from south to north and with an area in the northwestern part of the area characterized by the presence of both high pressure and high temperature indicator minerals that include andalusite, kyanite, sillimanite, staurolite, cordierite, anthophyllite, and garnet. This area also appears to have been subjected to extensive metasomatic alteration.

Stratigraphic correlation in the map-area is hampered by complex folding, faulting parallel to and across stratigraphy, metasomatic alteration and a complex metamorphic history, lack of reliable facing structures, intrusion of the granitic complexes, and lack of outcrop in critical areas due to extensive Pleistocene cover.

Early Precambrian (Archean)

METAVOLCANICS AND METASEDIMENTS

Metavolcanics

The metavolcanics within the map-area have been subdivided for mapping purposes into: felsic to intermediate and mafic to intermediate groups. Specific units characterized by a predominantly felsic or intermediate composition are so noted on the map.

Grab samples for analysis were selected to be as free as possible of alteration effects.

The fragmental rocks show extensive signs of reworking. They vary in character from reworked pyroclastic to volcanogenic sedimentary rocks, suggesting the possible addition or removal of specific mineralogical and thus compositional components. In the west-central part of the area, especially, they have been subjected to a rather high-grade metamorphism and show evidence of having been extensively metasomatized. Alteration, specifically carbonatization and silicification, also tend to mask the original composition of these rocks.

For these reasons care should be used in interpreting the chemical data obtained from the sampling of these rocks.

MAFIC TO INTERMEDIATE METAVOLCANICS

Mafic to intermediate metavolcanics comprise the majority of Formations A, C, upper part of E, and H in the Savant Lake metavolcanic-metasedimentary domain, and Formations C, E, and G in the Sturgeon Lake metavolcanic-metasedimentary domain, as well as occurring as intercalated units within most of the other formations. They have been metamorphosed to greenschist, amphibolite, and hornblende-hornfels facies rank. These rocks vary from massive to well foliated.

On weathered surfaces, mafic to intermediate metavolcanics metamorphosed under greenschist facies conditions are light green, grey-green, brown, to even white where extensively carbonatized. Fresh surfaces commonly show a darker hue than do weathered surfaces. Their greenschist facies metamorphic mineral assemblage comprises the following minerals: plagioclase (albite-oligoclase) $\pm$ quartz $\pm$ chlorite $\pm$ amphibolite (tremolite-actinolite series locally anthophyllite) $\pm$ epidote $\pm$ carbonate $\pm$ garnet $\pm$ accessories including opaque oxides, pyrite, pyrrhotite, trace chalcopryite, galena, sphalerite, apatite, and sphene.

Texturally, subophitic to ophitic, and rare isogranular primary volcanic textures are locally preserved by pseudomorphic recrystallization.

Massive Flows

Both fine-grained and medium- to coarse-grained flows or flow portions are prominent within the mafic to intermediate metavolcanic assemblages. The medium-grained flow material could represent the more central parts of thick flows or they could be intrusive sills comagmatic with the flows.

Porphyritic Flows

Porphyritic flows or porphyritic zones within flows, although uncommon, were locally observed. The pillowed metavolcanic flows, of Formation A, east of Harold and Harris Lakes locally contain less than 5 percent randomly oriented plagioclase phenocrysts. Rare porphyritic units observed in Formation C, though not distinctly pillowed, could be a continuation of two porphyritic pillowed units that are present within the continuation of this assemblage south of the present map-area (Trowell 1977c). This porphyritic zone has a stratigraphic position similar to those discussed by N.L. Green (1975), in that felsic to intermediate volcanism begins several hundred metres upsection from this zone and as Green suggests this zone could mark a change in volcanism from primarily tholeiitic to primarily calc-alkalic in composition. Not enough chemical data are available however, to confirm whether this hypothesis is true for the above mentioned and present map-area.

Anthophyllitic Flows

Several flows or flow units or possibly tuffaceous units, characterized by the presence of abundant fibrous amphibole, and locally containing abundant carbonate, occur within Formation H. The amphibole was tentatively identified in the field as tremolite, but a subsequent X-ray determination by the Geoscience Laboratories, Ontario Geological Survey, and thin section study by the author confirmed the amphibole to be anthophyllite.

These units weather light grey-green to buff to white with local rusty brown zones perhaps indicative of primary internal iron zonation. A strong penetrative schistosity locally gives these rocks a pseudobanded appearance. The schistosity is locally finely and highly crenulated. Zones comprised of coarser anthophyllite crystals do occur but their average size is less than 1 cm. The anthophyllite occurs both in individual blades or fibres up to 10 mm long and in unoriented rosette-shaped aggregates. Locally these units are amygdaloidal, the filling being a brown carbonate.

These units are less than 20 m thick and can be traced from the northern part of the map-area half way down the east side of Harris Lake. They are bounded on both sides by mafic flows of apparent basaltic composition. These anthophyllitic units may be the metamorphic equivalent of original high magnesia or ultramafic flows and/or tuffs. These units are not distinguished on the map-face by a separate code.

Pillowed Flows

Pillowed flows and flow units occur within all the mafic to intermediate metavolcanic formations with the possible exception of Formation H wherein pillows were tentatively identified in only one small outcrop.

Pillowed flows, generally nonvesicular, and locally containing sparse plagioclase feldspar phenocrysts comprise the majority of Formation A whereas in the other formations pillowed flows/flow units are intercalated with massive flows.

The colour of these pillowed flows is primarily a reflection of their metamorphic mineral assemblage though in general they tend to have a somewhat lighter hue than the massive flows with which they are intercalated. The selvages of the pillows are generally lighter in hue than the interior portion and they weather high.

In size, the pillows vary from 0.6 to 2 m long and 0.3 to 0.9 m thick in cross section. Length to thickness ratio varies from 2:1 to 10:1 reflecting both primary shape and/or deformation. The pillows are poorly to moderately well formed, and only locally could reliable top determinations be made.

Autoclastic Breccia

Autoclastic flow breccia comprising very fine grained subangular mafic to intermediate fragments set in a matrix of similar composition locally grade into and comprise either the upper or lower few feet of a massive volcanic flow.

Vesicular and Amygdaloidal Flows

Vesicular and amygdaloidal flows occur in Formations C and H. The pillowed units within these formations locally show a zone of vesicles or amygdules near their outer margin, with locally a concentration toward the top of an individual pillow.

Hyaloclastic Breccia

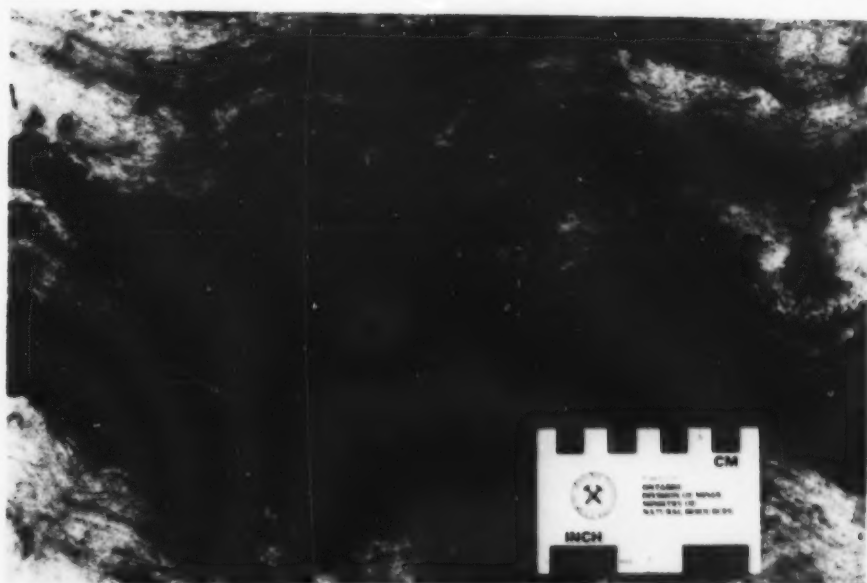
Whereas no definitely identified pillow hyaloclastic breccia units were seen accompanying the pillowed flows/flow units, some of the mafic fragments locally present within volcanogenic metasediments of Formation D in the northwestern part of the map-area were interpreted as fine hyaloclastic debris (see section on Mixed Unit, in Felsic to Intermediate Metavolcanics).

Pyroclastic and Volcanogenic Metasediments

Mafic to intermediate pyroclastic and minor volcanogenic metasediments generally occur as thin interflow units between the mafic to intermediate flows. Several, generally thin, apparently stratified units of crystal, rarely lithic crystal mafic tuff, were mapped within formations D, E, F, H, and I and their rather widespread dispersal suggests that explosive mafic volcanic activity provided substantial amounts of background material that was incorporated within the felsic to intermediate volcanic clastic rocks. Some of these units, however, rather than being tuffs could be amphibolitic metasedimentary calc-silicate units or sheared and re-crystallized mafic flows (Photo 1).

Similarly thin (less than 2 cm) amphibolite bands that commonly accompany the bands of magnetic iron formation could be either of tuffaceous or calc-silicate sedimentary origin.

Zones of amphibolitic mafic tuff were observed in Formation E in the southern part of the area commonly intermixed with fine pelitic metasedimentary material.



OGS 10 187

Photo 1—Amphibolitic layer (dark grey) intercalated within wacke beds of Formation F. Layer may be of mafic tuffaceous or calc-silicate origin. Outcrop is located along Harold Lake road.

Amphibolite

Amphibolites of predominantly volcanic flow origin, though possibly including mafic intrusive equivalents, are found, primarily adjacent to the granitic complexes. They are not distinguished as amphibolites on the map as their primary volcanic nature could for the most part be determined. The amphibolitized zone appears much wider on the east side of the metavolcanic-metasedimentary sequence perhaps indicating that the Eastern Granitic Complex plunges rather shallowly under it.

The amphibolitic rocks weather grey-green to dark green to locally black whereas on the fresh surface they are dark green to black. Their metamorphic mineral assemblage is comprised of plagioclase (oligoclase-andesine) + quartz + amphibole (actinolite, hornblende) $\pm$ biotite $\pm$ garnet $\pm$ epidote $\pm$ clinopyroxene $\pm$ carbonate + accessories including pyrite, pyrrhotite, chalcopyrite, trace galena and sphalerite, opaque oxides, sphene, and apatite.

The amphibolitized metavolcanics occur in three fabric types: (1) well foliated to layered amphibolite wherein alternating feldspathic and mafic-rich bands define a compositional layering; (2) porphyroblastic amphibolite wherein medium- to coarse-grained hornblende laths are set in a fine-grained matrix; and (3) massive equigranular amphibolites in which the subhedral to euhedral, approximately equant plagioclase and hornblende grains are intergrown in an unoriented decussate texture.

The layering of the well foliated to layered amphibolites could have several possible origins including accentuation of original stratification such as bedding in mafic ash-tuff, metamorphic differentiation with the compositional layering being developed parallel to a tectonic foliation, or dynamic layering in which pillows or possibly fragments have been stretched parallel to the foliation to such an extent that what appears to be contrasting feldspathic and mafic-rich bands are in fact pillow selvages and pillow interiors respectively.

The decussate texture of the massive equigranular amphibolites may have formed by recrystallization of original medium-grained, massive to weakly foliated mafic intrusive equivalents or of medium- to coarse-grained central flow portions.

In the porphyroblastic amphibolites two main growth forms are evident: (1) needle amphibolite in which the hornblende laths are highly elongated (needle habit reflecting nematoblastic growth) and are oriented subparallel defining a lineation (but not a foliation); and (2) rosette amphibolite in which the hornblende laths or needles form apparently unoriented rosette-shaped aggregates. Locally combinations of these fabrics were observed.

Medium red garnet (almandine) porphyroblasts occur within these amphibolitized rocks commonly forming glomeroporphyritic lensoid aggregates several centimetres in length surrounded by hornblende-rich rims.

Carbonate blobs and lensoid aggregates up to several centimetres in length are locally present and have probably formed by a metamorphic segregation process.

FELSIC TO INTERMEDIATE METAVOLCANICS

Felsic to intermediate metavolcanics are comprised of volcanic clastic rocks with volcanogenic sediments derived from pyroclastics and minor flows that have been metamorphosed under greenschist and amphibolite facies conditions. They predominantly comprise Formations D, E, G, and I in the Savant Lake and Sturgeon Lake metavolcanic-metasedimentary sequences.

All formations contain thin intercalated mafic to intermediate metavolcanic flows and tuffs, and siltstone-argillite metasedimentary units (generally classified under volcanogenic metasediments), and are intruded by gabbro and diorite sills, dikes, and irregular masses. The presence of these varied lithologies suggest a complex environment of formation and deposition marked by concomitant mafic and felsic volcanism, subaqueous working and reworking of original pyroclastic material, and volcanic associated intrusive activity.

The metamorphic mineral assemblages of these felsic to intermediate metavolcanics are as follows:

- (1) greenschist facies, chlorite subfacies: quartz + plagioclase (albite) + muscovite $\pm$ microcline (rare) $\pm$ chlorite $\pm$ chloritoid $\pm$ actinolite.
- (2) greenschist facies, biotite-chlorite subfacies: quartz + plagioclase (albite-oligoclase) + muscovite $\pm$ microcline $\pm$ biotite $\pm$ chloritoid $\pm$ garnet $\pm$ actinolite.
- (3) transitional facies: quartz + plagioclase (oligoclase) + muscovite

+ biotite $\pm$ chloritoid $\pm$ staurolite $\pm$ garnet $\pm$ chlorite $\pm$ amphibole (actinolite, hornblende).

(4) high greenschist to lower (?) amphibolite facies: quartz % plagioclase (oligoclase-andesine) + muscovite $\pm$ biotite $\pm$ garnet $\pm$ staurolite $\pm$ (anthophyllite, cummingtonite) $\pm$ aluminum silicate ($\pm$ andalusite $\pm$ kyanite $\pm$ sillimanite) cordierite $\pm$ clinopyroxene (diopside?).

Accessories include carbonate, epidote, iron-titanium oxide, magnetite, pyrite, zircon, sphene, pyrrhotite, chalcopyrite, tourmaline, hematite, prehnite, and talc.

Chloritoid was found within a relatively restricted zone within Formation D (Sturgeon Lake metavolcanic-metasedimentary sequence) and this zone represents the continuation of a zone that extends along the Northeast Arm of Sturgeon Lake (Trowell 1977c).

Coexisting euhedral staurolite and rosette-shaped chloritoid aggregates were observed (in thin section) in a layered volcanogenic metasedimentary unit from an outcrop just north of the road to Beckington Lake northeast of Ouilette Lake. To the north staurolite, alone, was found within the continuation of Formation D.

Andalusite was observed (in thin section) in several samples collected from a zone that extends down the central part of Formation D. Staurolite commonly accompanies the andalusite in these rocks.

Kyanite, accompanied by andalusite, was observed in outcrop west of Highway 599 in the northwestern part of the map-area, whereas sillimanite as fine-grained fibrolitic clots, accompanied by staurolite and anthophyllite, was observed (in thin section) from a sample located northwest of the kyanite occurrence. Cordierite was observed just west of Highway 599 and east of Evans Lake.

With the exception of one occurrence of chloritoid, cordierite, and the kyanite occurrence none of these metamorphic indicator minerals were recognized in the field. Temperature and pressure conditions no doubt existed under which kyanite, sillimanite, and andalusite were stable, however, the general bulk composition of the rocks in the area were in the main, unsuitable to allow formation of these minerals. The presence of these minerals therefore reflects the influence of uncommon primary or secondary phenomena. The zone and/or lithologic units containing aluminum silicate minerals may represent a pre-metamorphic weathered zone wherein an aluminum surplus was developed because of weathering (Vogel 1975) or may represent original ash units which underwent extensive hydrothermal alteration to clay minerals. It is of interest that the only other known occurrence of kyanite (accompanied by andalusite) in the area is from the footwall zone of the Mattabi Mine orebody south of Sturgeon Lake. A partial chemical analysis of a grab sample from the kyanite-bearing unit indicated the presence of 71.0 and 23.3 percent silica and alumina respectively.

The felsic to intermediate metavolcanics are predominantly pyroclastic, reworked pyroclastic, and volcanogenic sedimentary in origin.

On the weathered surface these rocks are light grey, light green, white, pink, yellow, and locally brown owing to iron carbonate alteration, whereas on the fresh surfaces they have a correspondingly darker hue.

In the northwestern and north-central part of the map-area the felsic to intermediate metavolcanics are characterized by the presence of abundant mafic lenses, wisps, apparent clasts, and thin layers. One or several of the following possible processes could explain their presence: (1) intercalation of thin mafic flows or flow units which because of their less competent nature during deformation could have been extensively boudinaged; (2) concomitant felsic and mafic pyroclastic activity producing heterolithologic volcanic clastic debris; and (3) metasomatic alteration possibly involving a process of calcium metasomatism whereby calcium expelled from the underlying mafic metavolcanics (Formation C) during intrusion of the Western Granitic Complex combined with the iron and magnesia in these rocks and was fixed as metasomatic amphibole (hornblende, anthophyllite), clinopyroxene, and garnet. It was in this same part of the map-area that the aluminum silicate minerals discussed above were also found. An expanded discussion of this area is found under the section on Mixed Unit, farther along in this report.

Volcanic Clastic Rocks

The volcanic clastic rocks are comprised of pyroclastic, possibly minor autoclastic and hyaloclastic, and redeposited volcanic breccias and volcanogenic metasediments. The term volcanogenic metasediments is used to describe tuff units containing possible reworked and redeposited volcanic breccia material. They are thus part of the buildup and concomitant degradation of the volcanic edifice rather than representing sedimentary basin deposition. They are, therefore, grouped in with the volcanic rocks.

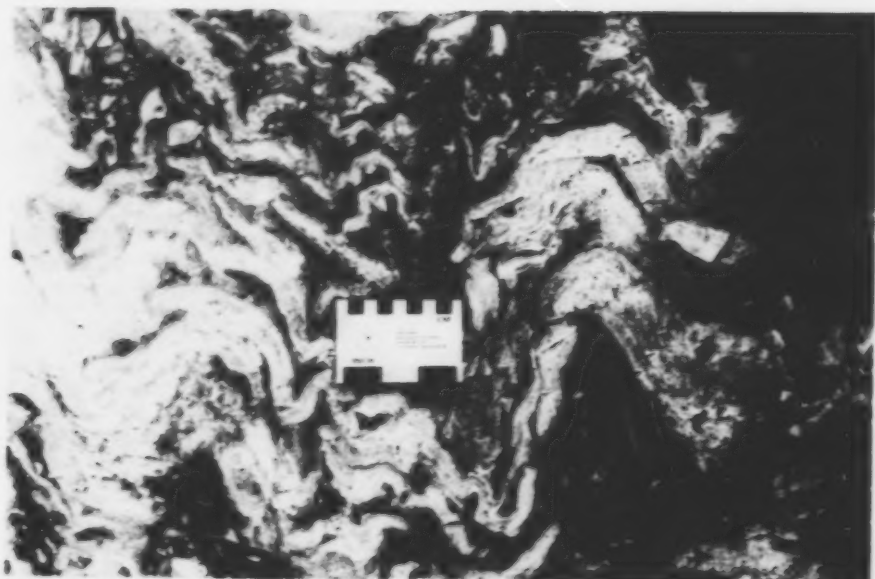
The pyroclastic rocks are dominantly coarse tuff to fine lapilli-tuff with local substantial accumulations of lapillistone to tuff-breccia and rare pyroclastic breccia.

These various sized fragmentals are commonly complexly interlayered over a very short distance both laterally and across strike. The tuff matrix is dominantly crystal to lithic-crystal. The lapilli and larger clast sizes in any one unit tend to be oligomictic and generally similar in composition to the matrix. Locally however they are polymictic, as for example; west of Harold Lake where a few rare, lapilli-sized, subrounded clasts of layered tuffaceous material were observed within an intermediate lapilli-tuff unit (see Harold Lake crystal tuff, this report).

A primary stratification was not identifiable in most of these rocks. A primary stratification was however exhibited by a zone of ash to lapilli-sized tuff (not delineated on the map) that is exposed west and south of Harold Lake. Parts of this zone are characterized by individual beds or groups of beds pulled apart to form a tectonic breccia (Photos 2 and 3). The zone also contains minor lapilli to pyroclastic breccia accessory clasts.

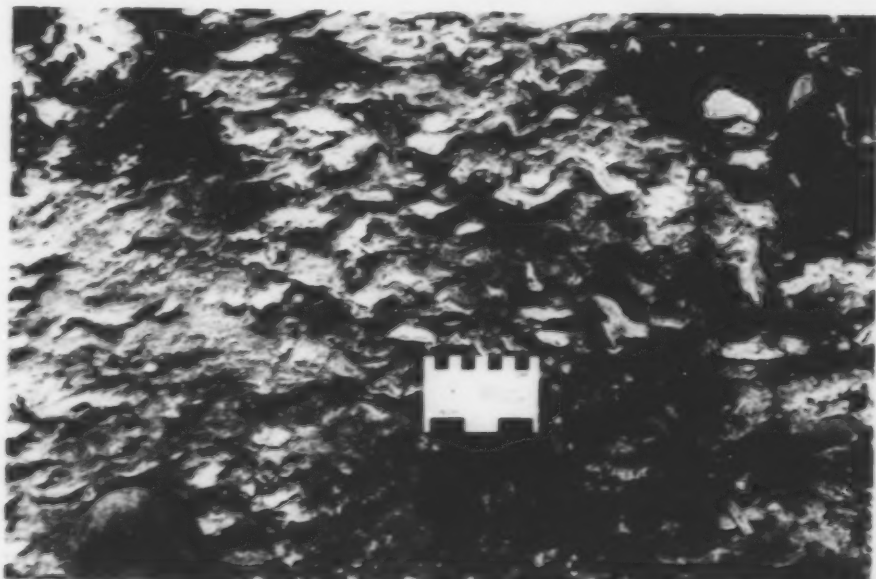
A unit within Formation D that is perhaps laharic in origin is exposed on Highway 599 just north of the contact with Formation C. This unit exhibits no stratification, no orientation of larger clasts, is matrix supported, exhibits poor sorting, and is heterolithic containing felsic, intermediate, and mafic volcanic clasts and some minor clasts of possibly sedimentary material.

Beckington Lake Area



DGS 10 188

Photo 2—Highly folded zone of volcanogenic metasediments in Formation I. Transitional to pull-apart breccia zone (see Photo 3). Outcrop is located along Harold Lake road.



DGS 10 189

Photo 3—Pull-apart breccia zone of Formation I. Individual finely laminated beds have been disrupted to extent that they appear as clasts set within a fine tuffaceous matrix. Outcrop is located along Harold Lake road.

Some of the more felsic ash-sized units in the northwestern part of the map-area are thought by the author to be of possible air-fall origin. Specifically the felsic unit containing kyanite may represent a subaerially deposited unit subsequently altered to clay minerals and then metamorphosed to give it its present mineral assemblage.

Some of the units that contain matrix supported subrounded clasts of volcanic material are probably volcanic-clast conglomerates, transported to their present position by some debris flow mechanism. Such a unit is exposed on Highway 599 northeast of Evans Lake. This unit is considered to be laharic in origin by W.R. Bulmer (1976).

Flows

Flows or flow units were in the main, defined on the basis of their non-fragmental nature, rare presence of finely banded and contorted internal structures that could represent primary flow banding, and an homogeneity of texture and composition over the span of the particular unit in question. Fine-, medium-grained, and porphyritic flows were all tentatively identified. However, when a flow origin was not certain, units were classified as 'flow/tuff'.

In Formation D several units characterized by the presence of subhedral plagioclase phenocrysts were interpreted to be of flow origin. Their composition, based upon mafic percent, lies in the intermediate range. Quartz phenocrysts locally accompany the plagioclase phenocrysts but in general the quartz is confined to the fine-grained groundmass. Small subparallel-aligned plagioclase laths in the groundmass may reflect primary flow banding.

Porphyritic Units

Several units exposed in Formation D specifically in the south-central part of the map-area are characterized by the presence of very large (1 to 2 cm) quartz phenocrysts that give these units a marked porphyritic appearance. The quartz phenocrysts are commonly blue, subhedral in form, and comprise approximately 10 percent of the unit. In thin section these phenocrysts show extensive recrystallization and generally exhibit strain lamellae indicative of moderate deformation. Plagioclase phenocrysts are locally present. In thin section they are moderately to extensively sericitized but locally show preserved oscillatory and/or normal zoning. The general lack of fragments in these units would suggest their origin to be either extrusive, as flows, or intrusive, as sub-volcanic feeders for the flows and pyroclastic material. Locally however, a few intermediate to felsic clasts were observed indicating either these porphyritic units had fragmental equivalents or else picked up these clasts during intrusion/extrusion.

In the northwestern part of the map-area the felsic to intermediate pyroclastics and volcanogenic metasediments are characterized by the presence of variable amounts of mafic lenses, wisps, clasts, and thin layers. The units exhibiting these features were previously designated by W.D. Bond (1977) as a 'mixed unit'. Bulmer (1976), in his capacity as a senior assistant on the present field project, did an undergraduate thesis study of a part of this 'mixed unit', and refers to it as follows (Bulmer 1976, p.4):

The mixed unit consisted primarily of a series of ash tuff—lapilli-tuff and tuffaceous metasedimentary units either intruded by or intercalated with a multitude of thin mafic sills or flows, and/or mafic ash units. These were tectonically deformed whereupon the mafic sills, flows, and/or mafic ash units were boudinaged, stretched and deformed into a myriad of shapes and sizes, generally represented by fist-sized knots, and S-shaped lenses and wisps.

Figure 3 illustrates the major lithologies that comprise the 'mixed unit' as determined by mapping by the field party and detailed mapping by Bulmer (1976).

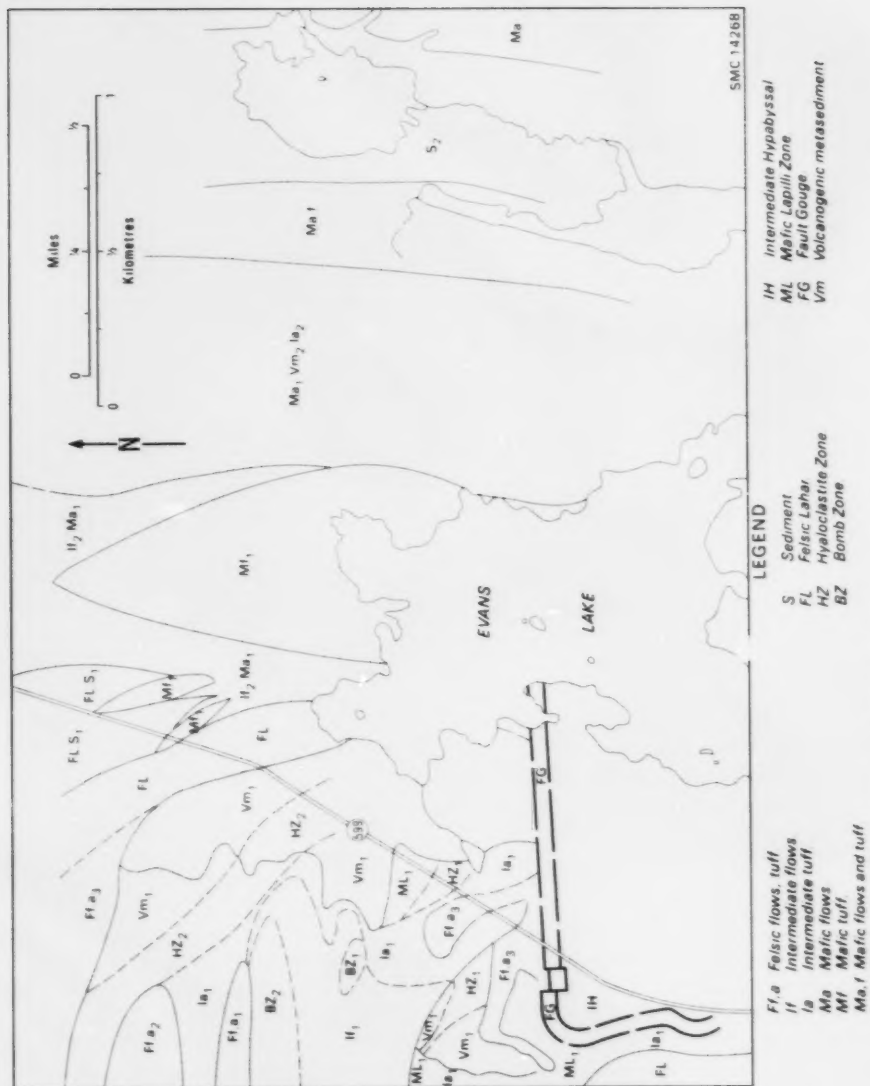
Examination of the lithological distribution (Figure 3) suggests that there is a sequential evolution of volcanic rock types and an interplay between volcanic and sedimentary deposition. The volcanic compositional development is illustrated by the upward change in the sequence from intermediate flows and tuffs to felsic tuffs with minor flows. The depositional variation is characterized by the change from intermediate and felsic tuffs and felsic debris flows in the west to volcanogenic metasediments in the east. West to east depositional change is also suggested by the change from massive mafic flows to hyaloclastic material admixed within the volcanogenic metasediments.

The mafic volcanic component in the form of lenses, knots, and wisps are only present in the pyroclastic and volcanogenic sedimentary units. For this reason they are considered to have formed by disruption of beds, thin sills, and flows and the incorporation of mafic ash rather than by metamorphic or metasomatic processes. The form of the mafic component appears to be determined by the amount of deformation the rock has undergone. Where deformation was weak, lenses and continuous beds or flows occur. In the more deformed zones, the lenses and beds are boudinaged and where deformation was intense knots and clots are found.

Bulmer (1976, p.56) summarized his thoughts on the 'mixed unit':

The area encompassed a lateral transition from a subaerial to subaqueous environment, and a vertical sequence of intermediate-felsic-intermediate-mafic flows and ash. A series of thin flows, ash and mafic lapilli units, as well as a zone of hyaloclastites intermingled with the volcanogenic metasediment and intermediate ash, which had undergone mild-intense deformation was responsible for a rather complex-chaotic appearing series of rocks. This series of rocks was termed the 'mixed unit'.

The present author suggests that the 'mixed unit' is a variety of peperite breccia resulting from interplay between mafic volcanic activity and sedimentation. The percentage of the mafic component in any individual outcrop reflects the availability of mafic volcanic material and the interaction between volcanism and sedimentation, and the form reflects the subsequent deformation of this zone.



Mafic volcanic flows deposited in a subaqueous environment possibly produced hyaloclastic material which was admixed with the volcanogenic metasediments. Pyroclastic activity could result in mafic bombs being incorporated in the volcanogenic metasediments with the thin wispy mafic layers representing background settling of fine ash. Thin mafic flows could have intruded the volcanogenic metasediments and the process of intrusion could have triggered contemporaneous soft sedimentary deformation producing the various forms observed. It is evident, however, that later structural deformation did exert final control on the presently observed form and distribution of the mafic components.

Harold Lake Crystal Tuff

Two major units of intermediate crystal tuff occur in the area of Harold Lake. They are locally bedded and facing-directions are determinable. They are only moderately deformed and volcanic textures and sedimentary structures are still recognizable. B. Cooke as senior assistant to the field party did an undergraduate thesis study of these units in order to determine their origin and the structure in the Harold Lake area. These units constitute a sizable pyroclastic unit of apparent intermediate to felsic composition. It was hoped that a detailed study of these units might allow for an interpretation of their possible economic significance.

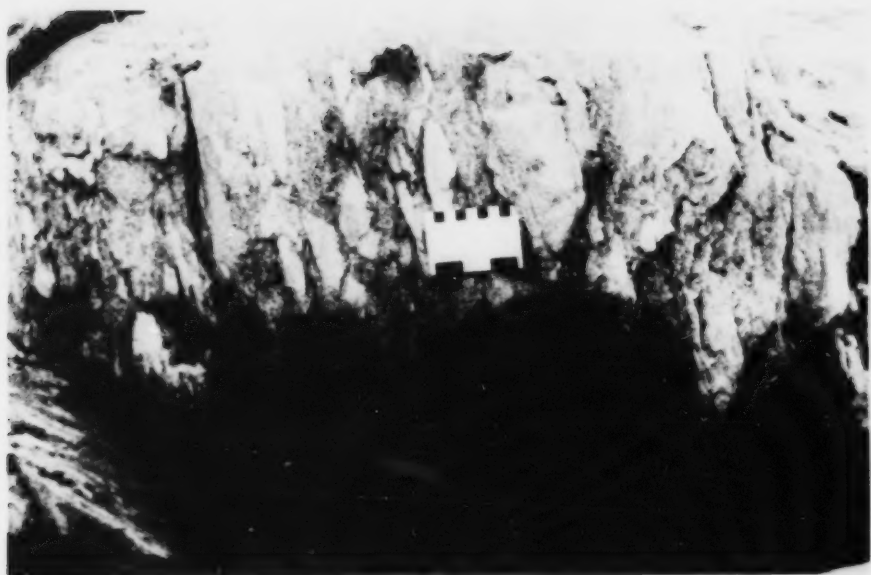
The first unit of crystal tuff is present on the south shore of Harold Lake and on the bush road to the south. It is about 2300 m long and 580 m wide. The second unit is exposed on the north and west shore of Harold Lake and on the bush road west of the lake. It is about 4690 m long and 760 m wide.

These units are comprised of the following mineral assemblage representative of upper greenschist facies metamorphism (Cooke 1976): albite-oligoclase (An_0 - An_{25}) with oligoclase-andesine (An_{24} - An_{36}) crystals locally present + quartz + muscovite + biotite $\pm$ chlorite + epidote + carbonate. Accessories include tourmaline, apatite, zircon, and pyrite.

Plagioclase occurs as subhedral to euhedral crystals and crystal fragments that average 2 mm but may reach 7 mm in length. Albite twinning is well preserved where deformation is slight, poorly preserved where deformation is more intense. Blue quartz crystals up to 3 mm long are generally a minor constituent of these units. The matrix is comprised of fine-grained quartz (60 to 80 percent), plagioclase (5 to 20 percent), biotite (0 to 25 percent), muscovite (5 to 10 percent), and chlorite. The biotite and muscovite commonly occur in straight to wispy, discontinuous layers. Chlorite locally occurs as an alteration of biotite. B. Cooke (1976) interprets these layers to represent the metamorphic equivalent of original clay-sized ash particles.

Some large clasts are present within the predominantly ash-sized units (Photo 4). They vary in size from a few centimetres to 1.5 m long and in composition from fine-grained mafic to fine-grained intermediate and felsic, to porphyritic intermediate.

Cooke (1976) studied the crystal size, crystal shape, percentage distribution of crystals, and presence and type of bedding structures in the crystal tuff



OGS 10 190

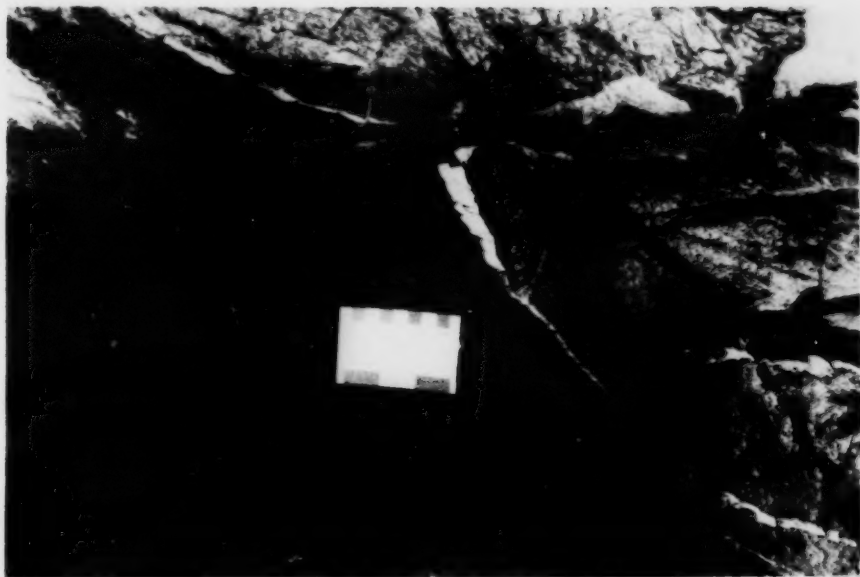
Photo 4—Tuff-breccia zone within Harold Lake crystal tuff. Note orientation and possible elongation of clasts that are parallel to fold axes nearby. Outcrop is located along west shore of Harold Lake.

units. He delineated so-called 'coarse crystal centres' wherein the plagioclase crystals are euhedral, greater than 2 mm in size, and comprise 25 percent of the rock. Bedding planes and biotitic and muscovitic layers are not present in these centres. Away from these centres Cooke (1976) observed rare graded bedding (Photo 5), muscovitic and biotitic layers, and a decrease in the average size of the plagioclase crystals.

Because of the discontinuous nature of the muscovitic and biotitic layers and because of the change from straight to wispy away from the 'coarse crystal centres' (Photo 6) Cooke interpreted them as having formed in a subaerial environment. He reasoned that if the fine ash that originally constituted these layers had been deposited subaqueously the layers would have been more continuous due to the more effective sorting action of water. He interpreted the 'coarse crystal centres' as being rapidly deposited near source accumulations of the coarser crystal and crystal fragment fraction. The larger clasts may also represent near source accumulations of material ejected from the vent walls or else could have been thrown out by stronger explosive activity to occupy their position as intercalated zones within the tuff units. No actual vent areas were delineated by this study however.

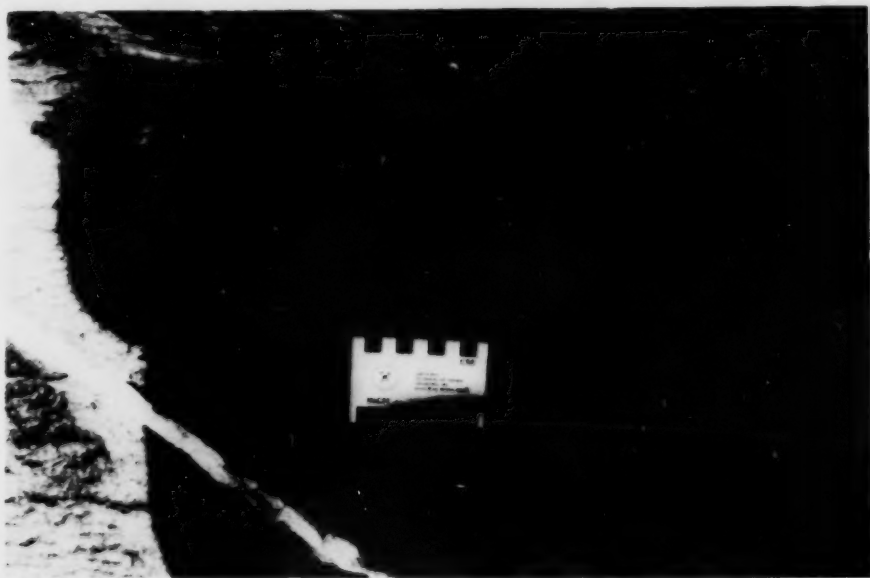
Some of the pyroclastic material was evidently deposited in water as illustrated by the transitional contact between these crystal tuff units and tuffaceous metasediments.

Beckington Lake Area



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Photo 5—Harold Lake crystal tuff showing massive crystal tuff bed with fine ash top. Tops, determined by grading, are to the top of photo. Outcrop is located along west shore of Harold Lake.



OGS 10 192

Photo 6—Wispy, discontinuous muscovitic layers within Harold Lake crystal tuff. Outcrop is located along west shore of Harold Lake.

In summary, Cooke (1976, p.50, 51) interprets the geological evolution of the Harold Lake area as follows:

The Harold Lake stratigraphy records variations in volcanic vent and depositional environments, following the accumulation of a thick sequence of subaqueous mafic flows. Minor ash tuff and detrital sedimentary horizons (including slaty iron formation) overlie the Savant Group conglomerate (where it is present) and the mafic flows. The shallow basin sedimentation was interrupted by the eruptions of a volcanic vent, which spewed out crystal-rich andesitic to dacitic magmas. The resultant volcanic pile is the lower, southern most part of the thesis unit.

Sedimentation became the dominant depositional process once again, as a rather continuous metasedimentary interval indicates. Sporadic volcanic activity contaminated the sediments with bombs, lapilli, crystals, and ash.

Another volcanic vent opened up to the north, allowing a thick blanket of crystal-rich andesitic-dacitic tuffs to accumulate followed by crystal-poor ash tuffs. Minor tuffaceous metasediment horizons occupy the flanks of this deposit. The culmination of intermediate composition volcanic activity is marked by an increase in ash and volcanic fragment contents in the tuffs. This sequence was subsequently covered by a thin mafic volcanic accumulation.

From his structural study of the area Cooke (1976) interpreted a possible doubly plunging synclinal structure in the Harold Lake area. He also mapped a shear zone that is present in metasediments on the south shore and in mafic flows and metasediments on the northeast shore of Harold Lake. This shear zone may be a continuation of the Savant Lake Fault zone to the north (Bond 1976). Chemical analyses of these units (Table 4) indicate they have an intermediate to slightly felsic composition. Mineralization was not observed in these units, however, and if they indeed formed in a subaerial environment the chances for base-metal sulphide mineralization to be associated with them is probably slight.

METAVOLCANIC PETROCHEMISTRY

Rock specimens collected and analyzed represent a cross section of the metavolcanics in the Savant Lake and Sturgeon Lake belts. The assignment of the rocks to their respective rock suites was determined by the Jensen Cation Plot computer program (Jensen 1976). The rocks were analyzed by the Geoscience Laboratories, Ontario Geological Survey. Only a few selected 'typical' analyses are presented. A more complete examination of the chemistry of these rocks will be presented in a later report.

The Jutten metavolcanics (Table 4), in the present map-area, are tholeiitic and are comprised of approximately equal amounts of high-iron and high-magnesium basalts (Jensen 1976).

The Harold Lake road section illustrates that the intermediate to felsic, flow and pyroclastic rock assemblages fall in the calc-alkalic field (Table 4, Analyses 3, 4, 5, 6) and the mafic flows in the tholeiitic generally high magnesium basalt field (Table 4, Analysis 7). The anthophyllitic flows fall in the ultramafic to basaltic komatiitic fields when plotted on the Jensen diagram (Table 4, Analysis 8).

The Highway 599 section illustrates that the lithologic units of Formation D are calc-alkalic and range from basalt to rhyolite (Table 4, Analyses 9, 10, 11, 12). Formation C as exposed in the Savant Lake metavolcanic-metasedimen-

TABLE 4 | CHEMICAL ANALYSES OF METAVOLCANICS IN WEIGHT PERCENT

HAROLD LAKE ROAD											HIGHWAY 599				
Sample No.	1	2	3	4	5	6	7	8	9	10					
SiO ₂	56.9	49.4	58.8	60.4	67.8	74.3	50.1	46.0	58.7	60.0					
Al ₂ O ₃	13.5	15.4	15.8	14.1	15.3	13.2	15.2	6.81	15.8	16.9					
Fe ₂ O ₃	1.53	1.80	1.99	1.67	1.01	0.73	1.70	1.60	2.26	1.43					
FeO	8.61	9.16	5.80	2.94	2.52	1.61	9.94	10.4	6.94	5.40					
MgO	5.32	7.81	3.97	2.72	2.01	0.81	8.78	27.0	3.96	3.23					
CaO	9.02	12.6	6.77	6.30	9.25	2.33	8.70	1.79	5.13	5.26					
Na ₂ O	2.54	1.53	3.32	3.91	2.51	3.79	3.22	0.09	1.06	2.85					
K ₂ O	0.19	0.41	0.69	2.17	2.70	2.01	0.11	0.00	3.34	1.49					
H ₂ O ⁺	0.43	0.71	0.64	0.62	0.19	0.14	0.66	3.71	0.72	2.00					
H ₂ O ⁻	0.37	0.28	0.17	0.05	0.46	0.43	0.33	0.34	0.19	0.23					
CO ₂	0.07	0.10	0.10	3.74	0.55	0.44	0.08	3.16	0.29	0.17					
TiO ₂	1.31	0.79	0.84	0.46	0.39	0.33	1.07	0.32	0.82	0.85					
P ₂ O ₅	0.14	0.09	0.19	0.21	0.16	0.09	0.11	0.06	0.20	0.24					
S	0.01	0.08	0.01	0.03	0.01	0.01	0.01	0.15	0.01	0.01					
MnO	0.19	0.18	0.13	0.09	0.08	0.05	0.17	0.14	0.11	0.14					
Total	100.5	100.3	99.2	99.4	99.9	100.3	100.2	101.6	99.5	100.2					

Sample Number	LOCATION		DESCRIPTION
	Longitude	Latitude	
1	90°36'40"	50°18'07"	Dark green, medium-to fine-grained massive flow
2	90°37'11"	50°18'14"	Dark green, fine-grained massive flow
3	90°40'27"	50°18'51"	White buff, medium-grained flow
4	90°38'22"	50°18'43"	White to creamy fine ash tuff
5	90°38'01"	50°18'14"	Grey to pink tuff
6	90°37'50"	50°18'19"	White to pink crystal tuff/flow
7	90°40'18"	50°18'42"	Dark grey green, fine-grained massive flow
8	90°39'29"	50°19'23"	Blue-white, medium-to coarse-grained flow
9	90°42'23"	50°17'58"	Grey fine tuff
10	90°42'30"	50°16'53"	Grey, medium-to fine-grained tuff

BECKINGTON ROAD

HIGHWAY 599

Sample No.

	11	12	13	14	15	16	17	18	19	20	21
SiO ₂	64.8	78.8	49.2	46.6	50.8	59.9	69.2	68.2	69.1	46.8	46.4
Al ₂ O ₃	17.7	11.6	16.5	15.7	13.9	15.8	15.3	16.3	16.0	16.2	16.6
Fe ₂ O ₃	1.34	0.75	2.10	1.73	2.60	1.54	0.95	0.39	1.06	1.30	2.00
MgO	2.52	0.84	10.1	8.01	11.9	5.31	4.34	3.57	0.70	10.9	12.5
CaO	2.00	0.92	7.83	8.88	5.41	4.54	3.01	1.94	0.68	8.64	7.12
Na ₂ O	3.62	1.58	8.90	11.5	9.95	6.50	2.54	3.49	2.91	10.0	9.94
K ₂ O	2.40	0.39	2.75	2.21	1.79	3.74	1.25	1.94	5.38	2.30	1.88
H ₂ O ⁺	2.92	3.01	0.18	0.18	0.28	1.00	0.93	2.10	1.49	0.19	0.20
H ₂ O ⁻	0.65	0.34	0.32	0.60	0.72	0.87	2.34	0.77	0.36	1.98	1.16
CO ₂	0.23	0.45	0.25	0.19	0.33	0.25	0.33	0.40	0.19	0.28	0.19
TiO ₂	0.28	0.10	0.10	0.06	0.13	0.11	0.10	0.10	0.66	0.12	0.16
P ₂ O ₅	0.60	0.09	1.08	0.67	1.47	0.58	0.49	0.56	0.29	0.82	0.93
S	0.13	0.05	0.07	0.08	0.14	0.10	0.10	0.13	0.11	0.08	0.10
MnO	0.01	0.01	0.16	0.02	0.01	0.01	0.01	0.22	0.12	0.03	0.01
Total	0.05	0.03	0.20	0.21	0.24	0.14	0.09	0.05	0.03	0.29	0.29
	99.2	99.0	99.7	99.3	99.7	100.4	101.0	100.2	99.1	100.0	99.5

DESCRIPTION

LOCATION

Sample Number	Longitude	Latitude	DESCRIPTION
11	90°42'26"	50°17'33"	White, medium-to fine-grained tuff-breccia
12	90°42'16"	50°18'3"	Grey-white, fine tuff
13	90°42'10"	50°15'22"	Dark green, medium-to fine-grained massive flow
14	90°40'08"	50°11'58"	Green fine-grained to aphanitic massive flow
15	90°39'41"	50°11'51"	Grey green, fine-grained pillowed flow
16	90°35'55"	50°11'15"	White fine-grained quartz porphyrite flow
17	90°35'56"	50°11'10"	Grey green, fine-to medium-grained tuff
18	90°37'16"	50°11'33"	White quartz porphyritic tuff
19	90°36'57"	50°11'45"	White medium-to coarse-grained flow
20	90°33'47"	50°11'26"	Black, fine-grained massive flow
21	90°35'5.14,	50°11'13"	Green, medium-grained flow

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tary belt is tholeiitic and mainly comprised of high-magnesium flows (Table 4, Analysis 13).

The Beckington Lake road section indicates that Formation C is tholeiitic with a higher proportion of high-magnesium than of high-iron basalts (Table 4, Analyses 14, 15). The intermediate to felsic units of Formation D are predominantly calc-alkalic as in the Savant Lake metavolcanic-metasedimentary belt to the north (Table 4, Analyses 16, 17, 18, 19). Formation E is dominantly tholeiitic with approximately equal amounts of high-magnesium and high-iron basalts (Table 4, Analyses 20, 21).

Metasediments

Metasediments including conglomerate, wacke, minor arenite, siltstone, argillite, and iron formation comprise the majority of assemblage F, a part of Formations B and G, and interflow beds in Assemblage H. Thin metasedimentary units occur intercalated within the volcanic clastic assemblages but most have been classified as volcanogenic metasediments. The metasediments have been metamorphosed to the greenschist, lower amphibolite, and hornblende-hornfels rank. In Formation F a felsic to intermediate tuffaceous component is also present.

CONGLOMERATE

A metaconglomerate unit unconformably overlies Formation A (Jutten metavolcanics) in the eastern part of Boucher Township.

Bond (1976) and R.J. Shegelski and R.T. Bell (1976) have previously commented upon the existence of an angular unconformity between the Jutten metavolcanics and the conglomerate. Field evidence indicating the presence of an unconformity are:

- 1) on Kashaweogama Lake and on Stillar Bay, Savant Lake there are irregular erosional surfaces between the volcanics and conglomerate;
- 2) there are local major angular differences between the trend of the Jutten metavolcanics and the conglomerate;
- 3) clasts in the conglomerate relate to specific proximal sources in the underlying rocks.

Only criterion 2 was established by the author within the present map-area.

In the present map-area, the metaconglomerate unit is clast-supported and contains clasts composed predominantly of mafic volcanic rocks, with minor to major clasts composed of trondhjemite to granodiorite, and minor to major clasts of diorite, and felsic volcanic rocks. The granitoid and felsic volcanic clasts generally retain their subrounded to rounded form though locally they have a lensoid or disc form because of stretching in the foliation plane. The mafic volcanic clasts, being less competent, have highly elongated amoeboid forms where deformation was intense.

Of the clasts observed sizes range from 0.3 to 25 cm and average about 12

cm. The granitoid clasts invariably comprise the largest clast size followed by the felsic volcanic. The mafic volcanic clasts are generally highly deformed but appear to have been originally smaller, on the average, than the other clast types.

The matrix of the metaconglomerate approximates a lithic wacke in composition. It is medium to coarse sand-sized, and contains fine lithic clasts of similar composition as the larger clast sizes as well as subangular to subrounded quartz and feldspar grains, set in a matrix of quartz and plagioclase with associated biotite, chlorite, and hornblende.

In comparing Bond's data (Bond 1976) of clast size and abundance of the equivalent granitoid-clast conglomerate in the Conant, Jutten, and Smye Townships area directly to the north with similar data collected in the present map-area it would appear that both the average size and percentage of granitoid clasts decrease southwards.

East of Harold Lake, there are places where apparently two bands of this metaconglomerate separated by mafic metavolcanics are present. They may represent two discrete bands or more likely represent repetition of the same band owing to faulting (thrust).

No stratification or facing directions were identified within the metaconglomerate. Local subparallel alignment of the clasts possibly represents a primary imbrication or may be due to deformation. The metaconglomerate is poorly sorted and grading was not evident. Thin lenses of massive to locally thinly stratified wacke are locally present in the metaconglomerate near its western margin.

In the southern part of Boucher Township the metaconglomerate is in apparent though unobserved contact with the Eastern Granitic Complex or else is missing having been entirely removed by faulting and/or by intrusion.

Funk (1973) studied the granitoid phenoclasts in this metaconglomerate unit in the area to the north of the present area. His main conclusion was that the granitoid phenoclasts were derived from small local intrusions, probably subvolcanic in nature, that were part of the volcanic stratigraphy rather than from any vast basement complex.

The unconformity between the Jutten metavolcanics and the presence of granitoid clasts in the metaconglomerate that can be related to proximal granitoid intrusions (Shegelski 1976) indicate a period of deformation, intrusion, and uplift prior to the deposition of the succeeding volcanic and sedimentary assemblages. The granitoid clasts could have been derived by erosion of subvolcanic porphyry bodies associated with the Jutten period of volcanism as Funk (1973) states. They could however represent erosion of early phases of the surrounding granitoid rocks thus implying the possibility of a pre-existing sialic crust.

Shegelski and Bell (1976, p.28-22) reported that in their study of this conglomerate unit along the south arm of Savant Lake, north of the present map-area, the conglomerate was found to exhibit clast stratification, sorting, and grading and that it contained layers and lenses of massive greywacke (see section "Fine Clastic Metasediments" below). They suggested a mechanism of deposition from a rapidly moving turbid flow, the clasts being reseedimented cobbles from a distal terrain of marked relief. Shegelski and Bell proposed that the source terrain consisted of rocks equivalent to the Jutten metavolcanics and

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that the granitoid clasts were supplied by erosion of granitic bodies that intruded the Jutten metavolcanics.

FINE CLASTIC METASEDIMENTS

Wacke, Arenite, Siltstone, and Argillite

The fine clastic metasediments in the map-area are predominantly wacke, siltstone, and argillite with minor arenite. They comprise the majority of Formation F, and parts of Formations B, G, and I. They also occur as interflow beds within Formation H.

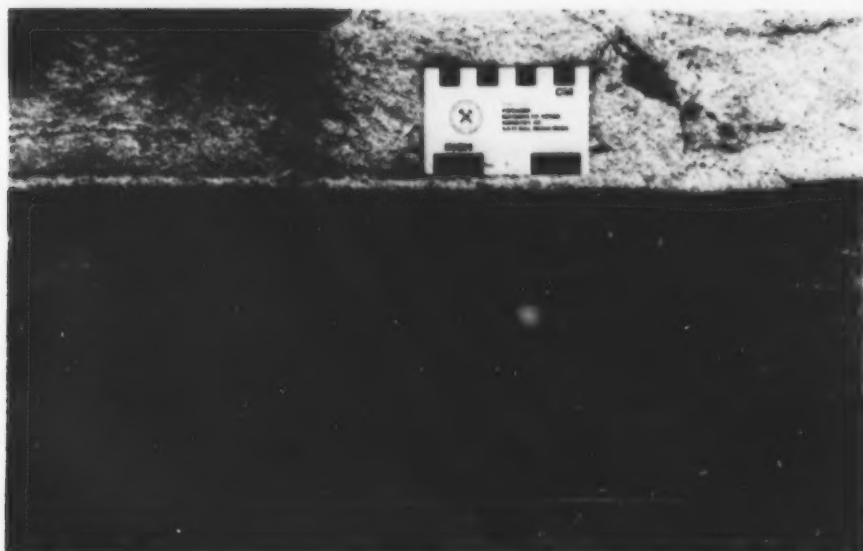
With reference to Formation F, Bond (1976) divided the finer metasediments into ferruginous and arenaceous. This subdivision was not followed in the present area as there would appear to be an overall decrease in magnetite content from the area in the north into the present map-area and as the magnetite appears to be dominantly confined to thin discrete bands of iron formation.

The metasediments of Formation B are mainly thin-bedded wacke-siltstone units that are intermixed with the upper part of the conglomerate member of Formation B. The wacke-siltstone units of Formation I are intermittently exposed on the islands and along the east and south shore of Jutten Lake. They thin and apparently pinch out just to the south of Jutten Lake. The beds are generally massive and are apparently ungraded.

The metasediments of Formation F, the thin lens within Formation G, and the interflow units within Formation H, are comprised of wacke, arenite, and siltstone.

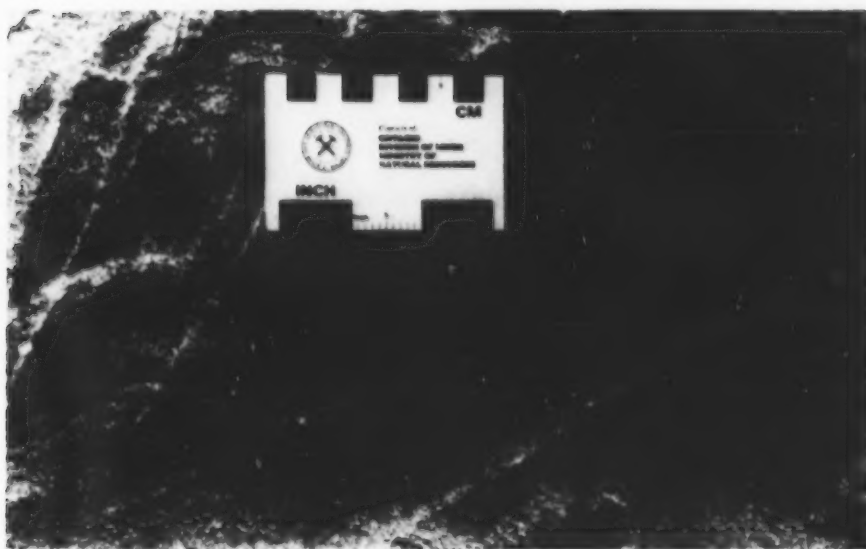
Partial Bouma cycles were noted within Formation F indicating deposition by turbidity currents. In the northern part of the area the individual beds are generally medium to locally thick-bedded, exhibit grain gradation (lower graded interval of Bouma cycle), are laminated (lower interval of parallel lamination), and show ripple drift cross lamination (interval of current ripple lamination). A pelitic interval or upper interval of parallel lamination was not definitely identified; neither were all divisions reported identified in each bed (Photos 7, 8). To the south individual beds are thinly to very thinly bedded, and exhibit Bouma sequences suggestive of a more distal environment of turbidity current deposition. No systematic study was carried out by the author so this conclusion is only tentative.

Mineralogically these metasedimentary units are comprised of the following metamorphic assemblages: greenschist facies: quartz + plagioclase (albite-oligoclase) + biotite + muscovite + epidote $\pm$ magnetite $\pm$ amphibole (tremolite-actinolite) $\pm$ carbonate; and almandine amphibolite facies: quartz $\pm$ plagioclase (oligoclase-andesine) + biotite + muscovite + epidote $\pm$ amphibole (hornblende) $\pm$ garnet $\pm$ carbonate + magnetite. Accessory minerals include sphene, zircon, pyrite, and pyrrhotite.



OGS 10 193

Photo 7—Partial Bouma ACD(E) cycle in wacke unit of Formation F. Tops to top of photo. Outcrop is located along Harold Lake road.



OGS 10 194

Photo 8—Contorted Bouma C division in wacke unit of Formation F. Outcrop is located along Harold Lake road.



OGS 10 195

Photo 9—Hornblende-quartz-magnetite iron formation units (black) intercalated within thinly laminated wacke-siltstone of Formation F. Outcrop is located along Harold Lake road.

IRON FORMATION

Hornblende-quartz-magnetite ($\pm$ sulphides) iron formation (Photo 9) was observed within Formations F and I in the northern part of the map-area whereas pyrite-pyrrhotite ($\pm$ graphite) iron formation is reported from diamond drill holes (see Description of Properties) from several of the formations from the central and southern part of the area.

The individual hornblende-quartz-magnetite iron formation bands are extremely thin (on the order of several millimetres to 3 cm) and are intercalated within wacke-siltstone units (Photo 9). The pyrite pyrrhotite ($\pm$ graphite) iron formation units occur both within metavolcanics and metasediments.

MAFIC INTRUSIVE ROCKS

The mafic intrusive rocks in the map-area comprise gabbro and diorite, and minor porphyritic (feldspar) gabbro and diorite (locally variable to quartz diorite and mafic trondhjemitic, not on map-face). These intrusive rocks occur as sills, dikes, and irregular masses that have intruded into the predominantly metavolcanic assemblages. They generally appear to be comagmatic with and represent the intrusive equivalents of the mafic to intermediate metavolcanic

assemblages they commonly intrude. Where their contacts with surrounding lithologies were not exposed they were tentatively interpreted as intrusive rocks on the basis of their medium-grained, subophitic to ophitic texture, and massive to weakly foliated structure, although they still could be flow rocks. They were distinguished with difficulty where they had intruded into amphibolitized mafic metavolcanics. In the area between Ouilette Lake and the Canadian National Railways line apparent mafic intrusive rocks might be more aptly described as medium- to coarse-grained amphibolite. In this area they would appear to have quite irregular shapes and their intrusion appears to have buckled the rocks they intrude possibly prior to regional deformation.

The distinction between gabbro and diorite is based on field criteria wherein rocks with less than 35 percent mafic minerals are called diorite, and rocks with more than 35 percent mafics are called gabbro. No major chemical differences were noted between these two rock types and both types were present within many outcrops grading from one to the other.

FELSIC INTRUSIVE ROCKS

Batholithic Granitic Complexes

EASTERN GRANITIC COMPLEX

The metavolcanic-metasedimentary belt is bounded on the east by a batholithic granitic complex a part of which underlies the eastern part of the map-area. Compositionally the rock varies from trondhjemite along its margins to granodiorite gradually changing to quartz monzonite to the east. Texturally it is generally medium grained and varies from equigranular to porphyritic. Its contact with the metavolcanic-metasedimentary belt is locally concordant but generally discordant and it would appear that large parts of the belt have been removed as a result of intrusion of this complex; zones carrying inclusions of amphibolite, presumably representing remnants of the lower mafic metavolcanic assemblage were locally observed within this complex. In the far eastern part of the map-area, south and east of Devizes Lake, the amphibolitized mafic metavolcanics gradually tail off into a zone of migmatite within this complex.

The mineral assemblage of this complex is plagioclase + quartz + microcline + biotite $\pm$ chlorite $\pm$ sericite. Accessory minerals include carbonate, magnetite, sphene; and minor zircon and rutile. Both plagioclase (oligoclase) in the granodiorite and microcline in the quartz monzonite occur as phenocrysts.

This complex is moderately to well foliated with the foliation being generally discordant to that within the metavolcanic-metasedimentary belt and to its contact with the belt.

Locally aplite dikes cut both the metavolcanics and units of the complex itself (not distinguished on map-face). Pegmatite was not seen in the Eastern Granitic Complex.

WESTERN GRANITIC COMPLEX

The border phases of the Western Granitic Complex underlie the southwestern and west-central parts of the map-area. The eastern boundary is the Beckington Lake metavolcanic-metasedimentary belt.

The granitoid rocks of the Western Granitic Complex in contrast to the rocks of the Eastern Granitic Complex are less strongly foliated, are coarser grained, and are comprised predominantly of trondhjemite with only minor granodiorite. Intrusion into the metavolcanic-metasedimentary sequence appears to have been passive in nature, with the granitoid phases effectively stopping the mafic metavolcanics so that the large blocks or rafts of mafic metavolcanics and minor intermediate metavolcanics now float in a granitoid matrix.

The mineral assemblage of this complex is plagioclase (oligoclase) + quartz $\pm$ microcline (rare) + biotite $\pm$ hornblende $\pm$ sericite. Accessory minerals include sphene, carbonate, minor pyrite, and epidote. Although of similar composition several textural phases are locally observed. These textural phases were distinguished by a variation in grain size; type and dominance of phenocrysts and mafic mineral distribution. These textural phases intrude one another in the form of sills and dikes. They all, however, approximate biotite trondhjemite in composition.

LATE FELSIC INTRUSIVE ROCKS

A body (sill/s) of granodiorite variable to monzonite may underlie the lake just to the east of the south end of Beckington Lake. Outcrops of biotite-hornblende granodiorite variable to monzonite that are locally feldspar porphyritic are exposed along the shoreline of this lake where they intrude mafic metavolcanics. Hand specimen examination would suggest that this body is mineralogically and texturally similar to the Vista Lake, Flindt River, and Vanessa Lake intrusive complexes south of the map-area described previously by the author (Trowell 1977c).

Similarly a separate pluton of granodiorite to quartz monzonite may also be present east of Harris Lake. No contacts were seen with the Eastern Granitic Complex to confirm this hypothesis.

PEGMATITE

A pegmatite dike (0.7 m wide by 2.5 m long as exposed) is present along the Harold Lake road where it cuts metasediments of Formation F. Hand specimen examination indicated that it is comprised of major quartz and potassic feldspar, minor muscovite, and a fine-grained dark black, finely disseminated mineral tentatively identified as fluorite. The position of the pegmatite is labelled on the map-face, but does not appear in the legend or Table of Lithologic Units.

Pegmatites are rare and are not associated with the contacts between the

Eastern and Western Granitic Complexes and the metavolcanic-metasedimentary belts. This pegmatite may therefore be related to a different granitic intrusion that possibly underlies this section of the metavolcanic-metasedimentary belt, at a relatively shallow depth.

Quaternary

PLEISTOCENE

During the Pleistocene Epoch, the map-area was covered by several ice sheets (Prest 1970), the last of which the Patricia Ice Mass (Zoltai 1965a) retreated at the end of the Wisconsinan stage. The pre-Pleistocene topography was modified by these ice sheets and ice-dammed glacial Lake Agassiz.

Glacial striae, esker, and esker-outwash and glacial fluting trend relatively consistently southwest to south-southwest.

The majority of the area is covered by a thin layer of Pleistocene sand and gravel deposits locally reworked by glacial-lake action. A major esker trends approximately south-southwest through the central part of the map-area ending in a relatively large and thick expanse of glaciofluvial sand and gravel in the south-central part of the map-area.

RECENT

Recent swamp or muskeg deposits are common though they are generally of limited extent. These deposits are generally organic in nature locally approaching peat. Sand beaches are rare and when present appear to have formed owing to lacustrine reworking of Pleistocene deposits.

J.A. Elson (1961) gives a brief description of the soil types present in the Lake Agassiz region.

METAMORPHISM

The metavolcanic-metasedimentary belts have been metamorphosed to the greenschist and lower almandine-amphibolite facies rank. The metamorphism and metamorphic assemblages of the various lithologies have been previously discussed. In general it would appear there is an increase in metamorphic rank from south to north suggestive perhaps of a thinning of the metavolcanic-metasedimentary sequence also from south to north. The Savant Lake metavolcanic-metasedimentary belt is comprised of a central part of biotite-chlorite greenschist facies metamorphic rank bounded by two extensive zones of lower amphibolite facies metamorphic rank. The Sturgeon Lake metavolcanic-metasedimentary belt is comprised of a central zone of chlorite greenschist facies metamorphic rank bounded by two zones of upper greenschist to lower amphibolite facies rank.

The presence of the indicator minerals kyanite, sillimanite, andalusite, cordierite, diopside, and anthophyllite in the northwestern part of the area perhaps reflect local inhomogeneities in the regional metamorphic pattern, associated with the various regional deformation events, as outlined under Structural Geology. The dominant structure in this area is a northeast-trending antiform and it may be that the Western Granitic Complex plunges rather shallowly under this structure resulting in amphibolite facies metamorphism well into the metavolcanic-metasedimentary belt.

STRUCTURAL GEOLOGY

Within the map-area the Jutten mafic metavolcanics (Formation A) comprise the oldest supracrustal sequence of rocks. They face north and are unconformably overlain by a granitoid-clast conglomerate (Formation B). In the Savant part of the metavolcanic-metasedimentary belt the Jutten metavolcanic sequence is overlain by the Handy Lake (Rittenhouse 1936) sequence (Formations C, D, E, F, G, H, I) of metavolcanics. The Handy Lake volcanics face dominantly east. Bond (1977) believes that the Handy Lake volcanics are older than the 'Savant series of metasediment' (Bond 1977) exposed to the north of the present map-area. Some of the sandstone units (Formation I) on the east side of Harold Lake may represent the southward extension of the 'Savant Series of metasediments'. The volcanic fragmental units on the east side of Harold Lake may be the distal equivalent of the 'Savant sequence of pyroclastics' (Bond 1977) in the Savant Lake area to the north; that is, they are pre-Handy Lake volcanics in age. If these metasediments and volcanic fragmental units are indeed pre-Handy Lake volcanics in age they are therefore not part of but rather are conformably overlain by Formation I. To the south, the Sturgeon Lake metavolcanic-metasedimentary belt is dominated by mafic volcanism. The Jutten mafic metavolcanics and overlying conglomerate are not present. Also the upper Formations (G, H, and I) of the Handy Lake metavolcanics are not represented or are contemporaneous equivalents of mafic metavolcanics in the south.

In both areas the structure is complex involving both folding and faulting. Both the stratigraphy and structure are difficult to decipher owing to the lack of facing directions.

Foliation, Schistosity, and Crenulation

The majority of the metamorphic and metasedimentary rocks have a moderately to well developed metamorphic foliation, local schistosity, defined by the subparallel alignment of component mineral grains. The major foliation, formed during initial folding of these rocks, is generally subparallel to primary bedding structures, whereas axial plane foliations and finer crenulations arising out of subsequent folding are concordant to discordant to both the primary structures and initially developed foliation.

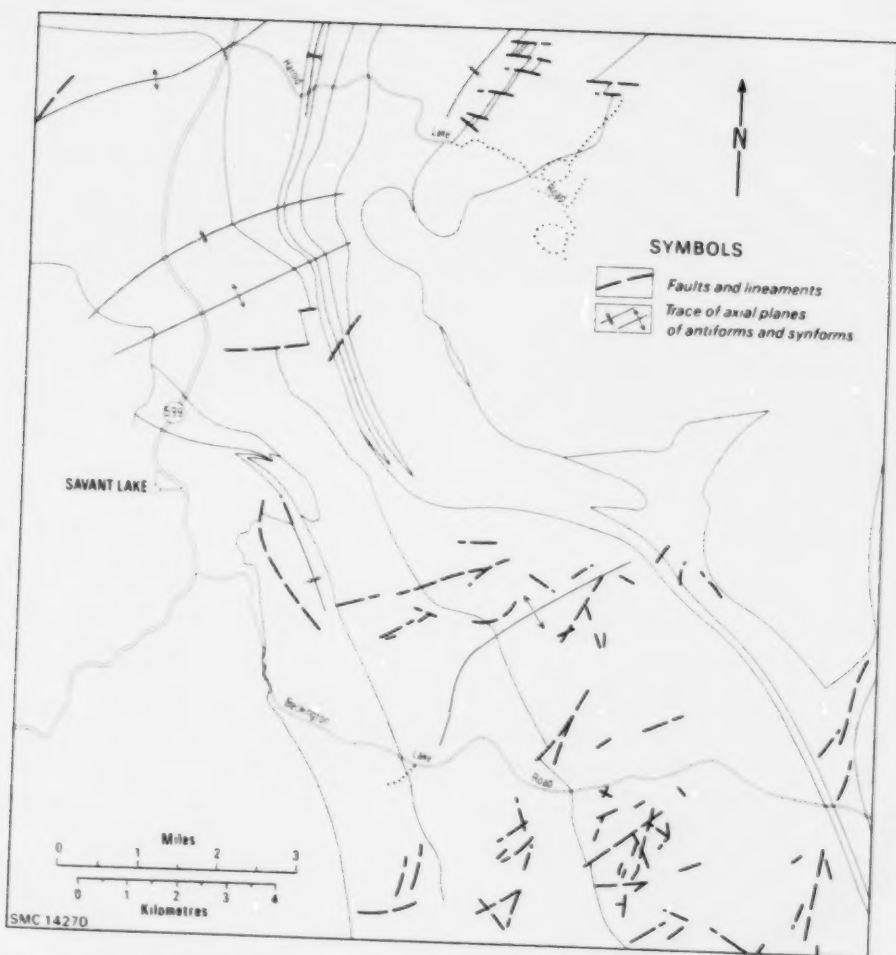


Figure 4—Schematic sketch illustrating the structure of the Beckington Lake area.

The Eastern Granitic Complex exhibits a moderate to well developed sub-parallel alignment of biotite whereas the Western Granitic Complex is massive to only locally foliated.

Folding

Figure 4 is a schematic representation of the map-area showing the approximate axial traces of antiformal and synformal structures as well as observed

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and assumed faults and lineaments. The lithological units trend approximately northwest to north.

A generally steeply dipping foliation approximately parallels the bedding. This foliation was probably developed during an initial folding episode about approximately subhorizontal fold axes.

The second phase of folding, its formation possibly arising owing to emplacement of the surrounding granitoid terrain, involved the development of major and minor folds both parallel to and across the initially developed foliation. This phase is responsible for the northeast-plunging antiformal structure that passes through the northwestern part of the area and for other large-scale flexures, such as the antiformal flexure present in the southern part of the area where there is a major change from northwest to west in the trend of the meta-volcanic-metasedimentary belt. The position of the intervening synformal and antiformal traces of axial planes between these two structures is speculative.

Folding with the fold axes developed approximately coplanar to the initially developed foliation is illustrated in the upper parts of Formation I where possible synclinal folding is indicated by facing reversals. Cooke (1976) has speculated that there is a doubly-plunging synclinal axis trending down the approximate centre of Harold Lake.

Faulting

Several faults have been interpreted in the map-area to explain offsets in the lithological assemblages but in general most linear structures detected primarily from air photographs have been depicted as lineaments.

Most lineaments and faults trend east to northeast and may have formed by a process of brittle fracture associated with late cross folding.

A fault or fault zone that may be the extension of the Savant Lake fault system (Bond 1977) is interpreted to extend down and west of Harold Lake. Cooke (1976) observed local zones of shearing on the shoreline and islands of Harold Lake. Also in this area there are: (1) muscovite and quartz-filled tension gashes (not distinguished on the map-face); and (2) a zone of tectonic 'pull-apart' breccia which may represent the southwestward extension of this fault zone.

CORRELATION OF GEOLOGY WITH AEROMAGNETIC DATA

The map-area was surveyed aeromagnetically in 1961, and the map sheets at a scale of 1:63 360 (1 inch to 1 mile) covering this area were jointly released by the Geological Survey of Canada and the Ontario Department of Mines (ODM-GSC 1961a,b,c,d).

The southern part of the map-area was partially covered by a detailed ground magnetic survey conducted by the Ontario Division of Mines in 1975 (Barlow 1974; 1975a).

The major magnetic features in the map-area are the contrast in magnetic pattern and response between the metavolcanic-metasedimentary sequences

and the surrounding granitoid rocks and the indicated presence of iron-rich zones and thin bands of iron formation within the metasedimentary and volcanic clastic rocks.

The contrast in magnetic response and pattern between the metavolcanic-metasedimentary sequences and surrounding granitoid rocks is best shown in the northeastern part of the map-area where there is a much tighter spacing of the gamma-contour intervals in the metavolcanics of Formation A, whereas more widely spaced contours lie over the granitoid rocks.

The granitoid rocks in the western part of the area contain several enclaves of metavolcanics. Their presence could explain why there is only a slight contrast in aeromagnetic response between the granitoid rocks and the metavolcanic-metasedimentary belt.

A zone having a magnetic response of up to 500 gammas above background (61,500 gammas) is present in the central part of Boucher Township. This zone of higher magnetic response reflects the presence of intercalated iron formation in the metasedimentary and volcanic clastic units of Formation I.

Over a great deal of the area between the top of Sturgeon Lake and the Canadian National Railways line the magnetic response and pattern is rather flat and does not aid in interpreting geological structures and the areal extent of specific lithologies. This is explained by the great thickness of overburden in this area.

ECONOMIC GEOLOGY

The discovery of several base-metal massive sulphide deposits south of Sturgeon Lake (see Table 1) resulted in the present map-area being intensively explored for similar deposits.

Sulphide Mineralization and Sulphide Iron Formation

Prior to 1970, exploration for base metals in the map-area had been mainly confined to examination of the Savant and Hadley deposits (see Golsil Mines Limited, Property 9 and E.W. Hadley Property 10 respectively in List of Properties).

Local areas of sulphide mineralization were noted specifically in Formation D in the northern part of the area. Grab samples were collected from these mineralized zones by the field party. Analyses (Geoscience Laboratories, Ontario Geological Survey) indicate that they contain only trace values of the base and precious metals. Mineralization is mainly comprised of pyrite and minor pyrrhotite and trace chalcopryite, sphalerite, and galena.

Several pyrite-pyrrhotite ($\pm$ graphite) iron formations are reported to be present in the metasedimentary and mafic metavolcanic assemblages (see Description of Properties). Of those tested, only trace amounts of chalcopryite or sphalerite are reported to be present.

Magnetite Iron Formation

Several units of magnetite iron formation are present within Formation F in the northern part of the area. These units, on the order of several millimetres to 3 cm in width, are interbedded with sandstone beds and thus are too small to warrant investigation from the standpoint of economic iron deposits.

Gold

Quartz veins and silicified zones that contain trace gold values in addition to minor pyrite and chalcopyrite mineralization are situated at the contact of mafic intrusive or extrusive rocks with felsic to intermediate metavolcanics, in the southern part of Formation D. The field party noted trenching on several of these zones but the grab samples collected by the field party and analyzed (by the Geoscience Laboratories, Ontario Geological Survey) indicated only trace values of precious and of base metals. The showings of the former Ouillette Mines Limited (17) (see Description of Properties) property appear to be associated with quartz veins along the contact between mafic intrusive rocks and felsic metavolcanics.

Description of Properties

Table 6 shows assessment and other information that has been submitted for the Beckington Lake area, up to the end of December 1975. The table gives the File Name and Ownership, Claim Map Area Name, Type of Information, Toronto File Number(s), Date of Work or File, and the corresponding number on map-face and in report.

Information concerning the described deposits and past and current properties was obtained from reports and maps of the Geological Survey of Canada, from the Assessment Files Research Office, Ontario Geological Survey, Toronto and from the Regional Geologist's Files, Ontario Ministry of Natural Resources, Sioux Lookout, Ontario.

TABLE 5 | **LEGEND FOR EXPLORATION WORK SHOWN IN TABLE 6.**

Geophysical Work	Number
Airborne: Magnetic	1
Electromagnetic	2
Ground: Magnetic	3
Electromagnetic	4
Horizontal Loop	4A
Vertical Loop	4B
V.L.F.	4C
Geological Work: Mapping	6
Diamond Drilling	7
(Number of drill holes and total footage)	(1-165')

* Indicates change in name

() Name in brackets holds or held option on claim group.

TABLE 6 | SUMMARY OF EXPLORATION FILES ON BECKINGTON LAKE AREA.

Name	BECKINGTON LAKE	BOUCHER TWP.	CHEVRIER TWP.	EVANS LAKE AND FOG LAKE AND MANION TWP.	Geophysical Work	Geological Work	Toronto File No. (s)	Number on Map	Year of Work
Amax Exploration Inc.	X				3 4C	6	2.155 2.570	1	1970 1971
Frederick O. Blake	X				3, 4A		2.626	1	1971
Canadian Nickel Company Ltd.	X					7 (5-816') 7 (4-824') 7 (3-489.9')		3 3 3	1968 1969 1970
Canex Aerial Exploration Ltd.				X	1, 2	7 (1-184')	2.138	4	1969 1970
Conwest Exploration Co. Ltd. - Selco Exploration Co. Ltd.	X				1, 2		2.500	5	1971
Dome Exploration Canada Ltd.			X			7 (2-625)		6	1970
H. Ferderber <i>et al.</i>		X		X	4A, 3		63 2892	7	1972
(Cam Mines Ltd.)		X		X	4A, 3		"		1972
Geophysical Engineering Ltd.		X		X			7 (1-432')	8	1972
Golsil Mines Ltd.				X	4B, 3	7 (8-1942')	63 978	9	1963
E.W. Hadley				X		7 (6-200')			1972
David A. Heino	X					7 (6-826')	2.529	11	1971
David A. Heino and Victor A. Niedolin (Tay River Mines Ltd.)	X	X			4A		2.112	12	1970

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AMAX EXPLORATION INCORPORATED [1971] (1)¹

In 1971, Amax Exploration Incorporated held a group of 12 unpatented claims (PA226351, PA226352, PA226337-PA226346) at the north end of Wellington Lake. In 1970 and 1971, Amax Exploration Incorporated carried out ground magnetic, electromagnetic, and geological surveys over the claim group.

This former property is underlain by a predominantly mafic to intermediate metavolcanic assemblage with minor thin metasedimentary interbeds and with intrusive granitoid rocks in the extreme eastern part of the claim group. No further work was reported and the claims were allowed to lapse.

FREDERICK O. BLAKE [1971] (2)

In 1971, Frederick O. Blake (MacDonald Mining Syndicate) held a group of 30 unpatented claims (PA261817-PA261846) 2.4 km (1.5 miles) north of Ouellette Lake.

In 1971, ground magnetic and electromagnetic surveys were conducted over the claim group.

This former property is underlain by a mixed assemblage of felsic to intermediate volcanic clastics, and possible felsic to intermediate flows, mafic metavolcanic flows, and intrusive gabbroic bodies. These claims have since lapsed.

CANADIAN NICKEL COMPANY LIMITED [1970] (3)

In 1968, Canadian Nickel Company Limited drilled five diamond drill holes (one each on claims PA44242, PA44243, PA43814, PA43815, PA43820) west of Harris Lake, having a total length of 816 feet. As reported in the assessment files these diamond drill holes intersected an assemblage of mafic metavolcanics and amphibolite, mafic intrusive rocks, felsic to intermediate metavolcanics, and metasediments. Mineralization was reported to consist of pyrite, pyrrhotite, and traces of chalcopyrite.

In 1969, Canadian Nickel Company Limited drilled four diamond drill holes (one each on claims PA44242 and PA210529 and two on PA44243) west and south of Harris Lake, having a total length of 824 feet. As reported in the assessment files these diamond drill holes intersected an assemblage of mafic to intermediate metavolcanics, feldspar porphyry, and various schists and gneisses. Mineralization was reported to consist of pyrite, pyrrhotite, and trace chalcopyrite; graphite locally accompanied the mineralization.

In 1970, Canadian Nickel Company Limited drilled three diamond drill holes (one each on claims PA210570, PA44071, PA210569) west of the southern part of Harris Lake, having a total length of 489.9 feet. As reported in the

¹Number in parentheses refers to property numbers shown on Map 2431, back pocket.

assessment files these diamond drill holes intersected an assemblage of mafic metavolcanics and amphibolite, various schists and gneisses, and mafic intrusive rocks. Mineralization was reported to consist of pyrite and pyrrhotite.

All claims were subsequently dropped.

CANEX AERIAL EXPLORATION LIMITED [1970] (4)

In 1969, Canex Aerial Exploration Limited held a group of 39 unpatented claims (PA243668-PA243681, PA243693-PA243717) west of Evans Lake.

In 1969 and 1970, Canex Aerial Exploration Limited conducted an airborne magnetic and electromagnetic survey respectively, over the claim group and drilled one diamond drill hole having a total length of 184 feet that intersected an assemblage of metasediments, intermediate metavolcanics, and a graphitic pyrite + pyrrhotite zone.

This former property is underlain by felsic to intermediate volcanic clastic units in the eastern part, and by mafic metavolcanic/intrusive rocks of Formation D in the western part.

The claims were subsequently dropped.

CONWEST EXPLORATION COMPANY LIMITED-SELCO EXPLORATION COMPANY LIMITED [1971] (5)

In 1971, Conwest Exploration Company Limited-Selco Exploration Company Limited held a group of 70 unpatented claims (PA244126, PA249483-PA249487, PA252874-PA252897, PA252899-PA252908, PA252945-PA252973) north of the Northeast Arm of Sturgeon Lake.

In 1971, airborne electromagnetic and magnetic surveys were conducted over the claim group.

This former claim group is underlain predominantly by mafic metavolcanics of Formation D and in the extreme western part of the claim group by volcanic clastic rocks of Formation E.

No follow up work was reported and the claims were allowed to lapse.

DOMEX EXPLORATION (CANADA) LIMITED [1970] (6)

In 1970, Dome Exploration (Canada) Limited drilled two diamond drill holes, one on each of claims PA210162 and PA210158, having a total length of 621 feet south of Devizes Lake. As reported in the assessment files these two diamond drill holes intersected a predominantly mafic metavolcanic assemblage with minor sericitic siliceous units, intrusive granitoid dikes, and carbonate + serpentine (visual determination) veinlets. Pyrite and pyrrhotite mineralization was reported to be present in the mafic metavolcanics and a small bleb of galena and sphalerite was reported to be found in a narrow carbonate veinlet. Nothing further was reported and the claims were dropped.

H. FERDERBER AND ASSOCIATES (CAM MINES LIMITED) [1972] (7)

In 1972, Cam Mines Limited held, under option from H. Ferderber, E. Hadley, N. Hibbart, R. Mackay, F. Nyman, and D. Thorsteinson, three groups of unpatented claims: (1) 26 claims (PA288395-PA288408, PA275615-PA275624, PA287652, PA287653) northwest of Evans Lake; (2) 35 claims (PA253493-PA253508, PA244156-PA244168, PA253509-PA253514) on and south of Evans Lake; and (3) 18 claims (PA249603-PA249606, PA249611-PA249617, PA302435, PA302436, PA302438, PA302443) southwest of Evans Lake.

In 1972, Cam Mines Limited carried out ground magnetic and electromagnetic surveys on these claim groups. All of these former claim groups are underlain by Formation D comprising a mixed sequence of volcanic clastic rocks, mafic flows and tuffs, and thin metasedimentary units.

GEOPHYSICAL ENGINEERING LIMITED (8)

In 1975, Geophysical Engineering Limited held a group of claims in Boucher Township and the area just north of Evans Lake.

In 1975, they drilled one diamond drill hole on claim PA 411616 having a length of 432 feet to test a geophysical anomaly. The diamond drill hole intersected an assemblage of intermediate to felsic volcanic clastics and possible flows and a mafic flow unit.

GOLSIL MINES LIMITED (SAVANT OCCURRENCE) [1963] (9)

In 1952, S. Johnston discovered a Cu-Pb-Zn-Ag occurrence (formerly known as Savant Prospect) on claim TB45329 located 6 km north of the Savant Lake Canadian National Railways station and 1.2 km west of Highway 599 (Shklanka 1969, p.169). Trenching was carried out in 1953 (by parties unknown) and in 1958 Lun-Echo Gold Mines Limited carried out a program of ground magnetic and electromagnetic surveys, X-ray diamond drilling, and trenching over the four claims (PA21392, PA21393, PA21388, PA21389) of their 16 claim property (PA21383-PA21398), that contained this occurrence. The occurrence that is located in the northwest corner of former claim PA21393 consists of disseminated pyrite, chalcopyrite, sphalerite, galena, and minor pyrrhotite mineralization within a sheared and chloritized zone in biotite-garnet (metasedimentary gneiss). It was reported that the zone strikes N35E and dips vertically. Mineralization extends over a strike-length of 200 feet and an exposed width of 40 feet. In 1963, Golsil Mines Limited drilled eight diamond drill holes having a total length of 1,942 feet in the vicinity of this occurrence. This second zone tested strikes N35E, dips vertically, and is 250 feet long, comprising two parallel zones 20 feet apart and each 5 feet in width. One of the better analysis gave 1.67 percent Cu, 1.44 percent Zn, 0.28 percent Pb, and 3.46 ounces Ag per ton over a width of 9 feet (Shklanka 1969). The claims were allowed to lapse.

E.W. HADLEY (HADLEY OCCURRENCE) (10)

In 1975, E.W. Hadley held a Zn-Pb-Cu-(Cd)-(Ag) occurrence (formerly known as the Hadley Prospect) discovered in 1968 during construction of Highway 599. The occurrence is located 5 km (3 miles) north of the village of Savant Lake on the west side of Highway 599.

This occurrence was examined in 1969 by D.W. Sullivan for Cam Mines Limited, which subsequently optioned the property from the then owner E.W. Hadley. At the time it was examined by Sullivan, four short trenches had tested this occurrence over a strike-length of 150 feet. Sullivan reported that the occurrence lies within felsic to intermediate metavolcanics that strike N15W and dip steeply northeast. He reported that it consists of bands and patches of massive sphalerite and galena, and minor chalcopyrite, and contains important values of cadmium and silver over a width of 4 feet. Analysis of a chip sample collected by Sullivan over 4 feet gave 21.80 percent Zn, 8.85 percent Pb, 0.08 percent Cd, 0.01 ounce Au per ton, and 1.88 ounces Ag per ton (File 63.2892, Cam Mines Limited, Assessment Files Research Office, Ontario Geological Survey, Toronto).

In 1972, E.W. Hadley drilled two diamond drill holes having a total length of 600 feet to test the depth extension of the occurrence. No significant mineralization was reported.

In 1975, E.W. Hadley performed soil trenching in the vicinity of this occurrence.

During the 1975 field season this occurrence was examined by the field party. Whereas the occurrence is associated with felsic to intermediate pyroclastics there are also present patches of amphibolite or metagabbro and a narrow diopside zone that may be the result of metasomatism or metamorphic segregation. Five grab samples from this occurrence, collected by the field party, were analyzed by the Geoscience Laboratories, Ontario Geological Survey. The analyses are presented in Table 8. The author considers it possible that this sulphide occurrence is in fact a fragment, detached from a larger sulphide mass (probably situated to the northwest) and mechanically incorporated in its present host rocks.

DAVID A. HEINO (TAY RIVER MINES LIMITED) [1970] (11)

In 1970, David A. Heino (Tay River Mines Limited) held a group of 10 unpatented claims (PA262230-PA262239) 1 km southeast of Harris Lake.

In 1970, a ground electromagnetic survey was conducted over this property. This former claim group is predominantly underlain by mafic metavolcanics of Formation C with possibly some minor volcanic clastic units of Formation D in the eastern part of the claim group. Almost the entire area of this former claim group is under a cover of glacial debris.

Nothing of economic interest was reported and the claims were allowed to lapse.

TABLE 7 | TRACE ELEMENT ANALYSES OF FIVE GRAB SAMPLES FROM HADLEY Zn-Pb-Cu-Ag-(Cd) OCCURRENCE
(ANALYSES IN PARTS PER MILLION EXCEPT WHERE NOTED)

Sample Number	Ag	Au (ppb)	Co	Cr	Cu	Hg (ppb)	Mn	Ti	Zn	Cd	S (percent)
305-1	25	170	20	10	25	15,800	890	300	404,000	3,080	23.6
305-2	1	230	8	8	1,880	90	910	3,000	1,200	8	0.54
305-3	1	150	5	6	450	50	280	3,000	310	4	0.17
305-4	8	120	45	5	120	5,800	2,230	35	222,000	1,560	13.1
305-5	15	600	20	6	390	2,400	1,180	1,500	162,000	1,050	9.81

DAVID A. HEINO AND VICTOR A. NIEDOLIN (TAY RIVER MINES LIMITED)
[1971] (12)

In 1971, David A. Heino and Victor A. Niedolin (Tay River Mines Limited) held a group of 23 unpatented claims (PA262240-PA262247, PA262293-PA262299, PA262301-PA262308) east of Richan Lake.

In 1971, a ground electromagnetic survey was conducted over this property and six diamond drill holes having a total length of 826 feet were drilled to test the anomalies detected during the survey. The diamond drill holes intersected an assemblage of mafic metavolcanics and pyroclastics, feldspar porphyry dikes, possible rhyolite, and garnet-mica schists (metasediments). Silicified and brecciated zones intersected by the diamond drill holes contained blebs and irregular bands of pyrite and pyrrhotite. No further work was reported.

This former property is underlain by an assemblage of amphibolitized mafic metavolcanics and thin intercalated metasedimentary units. No felsic metavolcanics were found while mapping this area.

THE INTERNATIONAL NICKEL COMPANY OF CANADA LIMITED [1969] (13)

In 1967, The International Nickel Company of Canada Limited drilled two diamond drill holes southeast of Rainbow Lake on claim PA 210526, having a total length of 202 feet. The diamond drill holes intersected an assemblage of intermediate metavolcanics, quartzite, sericitic, chloritic, and biotite-hornblende schist and possible felsic metavolcanics. Mineralization consisted of pyrite and pyrrhotite.

In 1968, one diamond drill hole having a total length of 206 feet was drilled on claim PA49223 west of Richan Lake that intersected an assemblage of mafic metavolcanics, metasediments, graphitic schist, and pyrite and pyrrhotite mineralization.

In 1969, two diamond drill holes were drilled: (1) one diamond drill hole, on claim PA210560 south of Richan Lake, had a total length of 200 feet and intersected an assemblage of mafic metavolcanics, graphitic schist and pyrite, pyrrhotite, and trace chalcopryrite mineralization; and (2) the second diamond drill hole on claim PA210542 west of Wellington Lake, had a total length of 150 feet and intersected an assemblage of metasediments, mafic metavolcanics, and pyrrhotite with trace chalcopryrite mineralization.

All claims were subsequently dropped.

McRAE MINING CORPORATION LIMITED [1970] (14)

In 1970, McRae Mining Corporation held a group of 26 unpatented claims (PA218460-PA218485) north of the Northeast Arm of Sturgeon Lake.

In 1970, airborne magnetic and electromagnetic surveys were conducted over the claim group. No follow up work was reported and the claims lapsed.

This former claim group is underlain by parts of Formations D and E.

NICKEL RIM MINES LIMITED (MID-NORTH ENGINEERING SERVICES LIMITED) [1971] (15)

In 1971, Nickel Rim Mines Limited held a group of 44 unpatented claims (PA238797-PA238802, PA250315-PA250319, PA253768-PA253786, PA254498-PA254505, PA261211, PA261218-PA261222) in the vicinity of Evans Lake and three claims (PA305712, PA305713, PA305391) in the north-central part of Boucher Township.

In 1971, Mid-North Engineering Services Limited conducted ground magnetic and electromagnetic surveys over these claims.

These former properties are underlain by rock units of Formations D to I comprised predominantly of metasediments and tuffaceous metasediments.

Mid-North Engineering Services Limited drilled 10 diamond drill holes, 1971 (one), and 1972 (nine), having a total length of 3,203 feet, to test several geophysical anomalies. The diamond drill holes intersected a predominantly metasedimentary assemblage of greywacke and locally graphitic greywacke. Minor amounts of pyrite, pyrrhotite, and trace sphalerite were reported to be present.

Nothing of economic interest was found and the claims were allowed to lapse.

NORANDA EXPLORATION COMPANY LIMITED (16)

In 1971, Noranda Exploration Company Limited held three groups of unpatented claims: (1) 11 claims (PA254056-PA254058), (PA254060-PA254064, PA254067-PA254069) southeast of Evans Lake; (2) 15 claims (PA288006-PA288014, PA239074, PA239061, PA305388-PA305390, PA288004) in the northwest corner of Boucher Township; and (3) 4 claims (PA263079-PA263082) 5 km east of the town of Savant Lake.

In 1971, ground magnetic and electromagnetic surveys were conducted over these claim groups, and one diamond drill hole, having a length of 300 feet was drilled on claim PA254068. It intersected mafic and intermediate volcanic flows with minor breccia zones. Pyrrhotite comprised the main mineralization intersected.

These former claim groups are underlain respectively by rock units of Formations D to H (Group 1), Formations D to I (Group 2), and Formation C (Group 3).

In 1974, Noranda Exploration Company Limited held three groups of unpatented claims: (1) 14 claims (PA421550-PA421563) 6 km north of the town of Savant Lake; (2) 18 claims (PA365631, PA365682, PA365686, PA365689-PA365695, PA403411-PA403418) 6.8 km southeast of the town of Savant Lake; and (3) 6 claims (PA432750-PA432755) 9.2 km north of the town of Savant Lake and 2.0 km west of Highway 599.

In 1974, ground magnetic and electromagnetic surveys were conducted over claim group (1) and in 1975, over claim groups (2) and (3).

No further work was reported.

OMAR EXPLORATIONS INCORPORATED [1970] (17)

In 1970, Omar Explorations Incorporated held a group of 17 unpatented claims (PA245725-PA245728, PA245730-PA245742) on and north of the southern part of Beckington Lake.

In 1970 ground magnetic and electromagnetic surveys were conducted over the claim group which is underlain by rock units of Formation E.

Nothing of economic interest was reported and the claims were allowed to lapse.

OUILLETTE MINES LIMITED [1962] (18)

In 1962 Ouilette Mines Limited held five claims northeast of Ouilette Lake. In 1946-1947, they had acquired these claims which then comprised a part of the former Richelieu claim group.

Geologist T.L. Gledhill (Assessment Files Research Office, Ontario Geological Survey, Toronto) had prepared a geological report of these claims, the report being acquired by Ouilette Mines Limited:

The main vein development so far is located near the centre of claim F.M. 206. This vein lies west of a large dike of acid porphyry. Trenching has exposed the vein at intervals for several hundred feet. The general strike of the vein is north 25 degrees east and the dip is about 60 degrees to the northwest. The average width on surface of the main vein is about 2 feet.

150 feet northwest of the north end of the main vein another vein has been uncovered, and also several others in various parts of the claims.

The main vein had been opened up by cross-trenches spaced along it at intervals and by two deep pits. The new vertical shaft is located on the hanging wall side of the main vein 112 feet west of the vein outcrop. The shaft has two compartments. The present depth is 157 feet. A station and level was established at 125 feet. From here a cross-cut was run for 133 feet to the east. The vein was cut 37 feet east of the shaft and then drifted on to the north and south. Following the vein north it maintained a 4-foot width for 30 feet from the cross-cut and showed a sparse mineralization by sulphides. From here to the north end of the drift the vein was ill-defined and the quartz acted more as a filling to a coarse breccia. Drifting south on the vein from the cross-cut the vein continued for 10 feet and then narrowed to a few inches. From here the south drift was turned to the east and the vein was picked up, widening to four and five feet of vein quartz with parallel bands of tourmaline showing more prominently; the walls of the vein were better defined and sulphides were commoner. Drifting was being continued to the southeast to get under the good ore section of the vein sampled on surface. There is no reason why the good ore found on surface should not be found on the 125-foot level. The vein will probably continue southeast on the 125-foot level until it reaches the porphyry dike and may then swing and follow the porphyry greenstone contact.

Structure and mineralogy of the Main Vein:

The gold veins are of the fissure type with the gold values in the vein quartz which has distinct walls. On surface the hanging or foot-wall position in the vein appear to be richer in gold. Near the vein walls a ribbon structure, of parallel bands of black tourmaline, is common. This feature is seen in the better vein sections. In the richer sections the vein walls appear to have been more readily sheared and the greenstone finer grained.

The vein minerals besides quartz, are tourmaline, ankerite, chalcopyrite, pyrite, and native gold. Chalcopyrite is more plentiful than pyrite. In a number of places free gold is seen in or near slips in the thin seams of black tourmaline found in the quartz. The quartz is of a light gray colour and of medium texture.

Beckington Lake Area

In 1960, Cromorr Mines Limited acquired this occurrence and carried out a program of diamond drilling to test for downward extensions of the gold-bearing veins.

In 1962, Ouillette Mines Limited carried out a program of assaying on their claim group.

This former claim group is underlain by felsic to intermediate metavolcanics intruded by irregularly shaped masses of gabbro. The contacts between these two units are locally silicified, quartz-veined, and carbonatized, possibly providing access for the type of gold mineralization described by Gledhill.

The actual significance of the mineralization as described by Gledhill is not known. Grab samples collected by the field party were assayed (Geoscience Laboratories, Ontario Geological Survey) but showed only trace values of gold and silver. The assay data available to Gledhill in the writing of his report are not now available so his use of the terms 'ore' and 'mineralization' should be carefully monitored.

ROBERT J. PENNEY, E. HADLEY, AND J. KONDRAT [1970] (19)

In 1970, Robert J. Penney, E. Hadley, and J. Kondrat held a group of 53 unpatented claims (PA222562-PA222564, PA230333-PA230335, PA230663-PA230669, PA230680-PA230681, PA230685, PA230686, PA244156-PA244168, PA249600-PA249601, PA249067, PA249608, PA253493-PA253514) over and west of Evan's Lake. The claims were predominantly underlain by rock units of Formation D.

In 1970, ground magnetic and electromagnetic surveys were conducted over the claim group but no follow-up work was reported and the claims were dropped.

PHELPS DODGE CORPORATION OF CANADA LIMITED [1971] (20)

In 1971, Phelps Dodge Corporation of Canada Limited held a group of seven unpatented claims (PA261074, PA261075, PA257652, PA257651, PA261077, PA257613, PA261076) southwest of Beckington Lake.

In 1971, they carried out a ground magnetic survey over the claim group but nothing of economic interest was reported and the claims were allowed to lapse.

This former claim group is predominantly underlain by mafic metavolcanics and intrusive rocks.

ROYEX MINING LIMITED [1970] (21)

In 1970, Royex Mining Limited held two groups of unpatented claims: (1) 23 claims (PA245722-PA245724, PA245708-PA245717, PA245704-PA245705, PA245686-PA245692) over the southern part of Beckington Lake and (2) 18

claims (PA245764-PA245766, PA245774-PA245783, PA245787-PA245791) over the northern part of Beckington Lake.

In 1970 Royex Mining Limited carried out ground magnetic and electromagnetic surveys over these claim groups. Nothing of economic interest was found.

These former claim groups are predominantly underlain by mafic metavolcanics.

H. SANDERS AND G.B. FENELON [1971] (22)

In 1971, H. Sanders and G.B. Fenelon, on behalf of W.T. MacDonald, held a group of 10 unpatented claims (PA305210-PA305215, PA309176-PA309178, PA275216) north of Ouilette Lake.

In 1971, ground magnetic and electromagnetic surveys were conducted over the claim group. This former property is underlain predominantly by rock units of Formation D.

ROCCO ANTHONY SCHIRALLI [1970] (23)

(Slocan Ottawa Mines Limited)

In 1970, R.A. Schiralli held a group of 17 unpatented claims (PA245693-PA245702, PA245706, PA245729, PA245718, PA245721) in the vicinity of Wellington Lake and underlain predominantly by mafic metavolcanics and rock units of the Eastern Granitic Complex.

In 1970, a ground magnetic survey was conducted over this claim group. No further work was reported and the claims were allowed to lapse.

SELCO EXPLORATION COMPANY LIMITED [1970] (24)

In 1970, Selco Exploration Company Limited held a group of 16 unpatented claims (PA201054-PA201057, PA201051, PA201060-PA201064, PA201045, PA201048, PA201050, PA201067) at Ouilette Lake.

In 1970, ground magnetic and electromagnetic surveys were conducted over the claim group which is underlain by rock units of Formations C and D. Five diamond drill holes having a total length of 772.5 feet were drilled to check the geophysical anomalies detected during the surveys. The diamond drill holes intersected an assemblage of mafic metavolcanics, diorite, intermediate and felsic tuffs, and siliceous zones containing pyrite and pyrrhotite mineralization.

The claims were subsequently dropped.

STURGEX MINES LIMITED [1971] (25)

In 1970, Sturgex Mines Limited held two groups of unpatented claims: (1) eight claims (PA257613, PA257583-PA257585, PA257596-PA257599) east of Wellington Lake and (2) eight claims (PA257574-PA257581) on Richan Lake.

In 1971, ground magnetic and electromagnetic surveys were conducted over both claim groups.

Eleven diamond drill holes, having a total length of 3,645.8 feet were drilled on claim group (1) in 1971. The diamond drill holes intersected an assemblage of mafic metavolcanics, felsic metavolcanics, and quartz-feldspar and feldspar porphyry. Mineralized zones consisted of pyrite + pyrrhotite and pyrite + pyrrhotite + graphite with pyrite predominant over pyrrhotite. Chalcopyrite is locally present in minor amounts. Sphalerite was tentatively identified in one diamond drill hole. This former claim group is underlain by rock units of Formation G.

Two diamond drill holes to test geophysical anomalies having a total length of 763 feet were drilled on claim group (2) in 1971. They intersected an assemblage of mafic metavolcanics, various schistose rocks, quartz-feldspar porphyry, and pyrite + graphite schist.

No further work was reported and the claims were allowed to lapse.

TEXORE MINES LIMITED [1970] (26)

In 1970, Texore Mines Limited held two groups of unpatented claims: (1) 10 claims (PA245767-PA245773, PA245784-PA245786) on and west of Richan Lake, and (2) 38 claims (PA245746-PA245763, PA246046-PA246065) on and west of the upper part of Beckington Lake. These claim groups are underlain by rock units of Formations C and D respectively.

In 1970, ground magnetic surveys were conducted over these claim groups, but nothing of economic interest was found and the claims were allowed to lapse.

Considerations in Future Exploration

Although no economic mineral deposits have yet been found in the map-area, the author feels that further exploration is warranted, specifically for base-metal sulphide mineralization.

The northwestern part of the area is underlain by rock units of Formation D comprising a rapidly alternating sequence of predominantly calc-alkalic flows, pyroclastics, reworked and redeposited pyroclastics, and volcanogenic metasediments. It also contains within it two base-metal sulphide occurrences, the Savant Occurrence (see Golsil Mines Limited, Number 9, in List of Properties) and Hadley Occurrence (see E.W. Hadley, Property 10, in List of Properties) respectively. Bond (1978) has reported that the rocks in the Houghton-Hough Lakes area which are equivalent to those of Formation D in the present

map-area are more dominantly pyroclastic to reworked pyroclastic in origin and thus possibly more proximal to a volcanic centre. The Savant and Hadley occurrences could represent distal mineralization and thus exploration should be directed towards this area of known mineralization and to the westward extension of Formation D in the present map-area and westward into the Houghton-Hough Lakes area (Bond 1978).

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